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AVIATION

The Oldest American Aeronautical Magazine

IN THIS ISSUE

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AVIATION

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THE OLDEST AMERICAN AERONAUTICAL MAGAZINE

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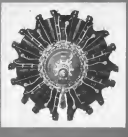
A 715 H.P. WRIGHT CYCLONE *powered the* LINDBERGHS' 30,000 *mile flight*



Colonel and Mrs. Charles A. Lindhergh's 30,000-mile flight covering twenty-one nations, including crossings of the North and South Atlantic Ocean, ranks as one of the major flights of history.

During this aerial tour, they visited Labrador, Greenland, Iceland, the British Isles, Europe, the Azores, Africa, South America and the West Indies before returning to the United States. Extremes of climatic conditions were encountered along the route, ranging from the sub-Arctic cold of Greenland and Iceland to the intense heat of tropical regions at the Equator.

A Wright Cyclone 715 h.p. Engine powered the Lockheed Sirius Monoplane that carried them all the way. What is more, the Cyclone gave perfect mechanical service throughout the entire distance—a proud performance.

Wright Engines and Colonel Lindbergh have made history together. A 220 h.p. Wright "Whirlwind" carried him in the "Spirit of St. Louis" to Paris on his first magnificent flight across the Atlantic. A 575 h.p. Wright "Cyclone" bore the Colonel and Mrs. Lindbergh from Washington, D. C., over the icy wastes of Northern Canada and Alaska to Japan and China. And a 715 h.p. Wright "Cyclone" served them well on this latest and longest journey.

Colonel Lindbergh is technical advisor to Pan American Airways System and Transcontinental & Western Air, two of the world's largest transport systems. From this flight, made in the interest of Pan American Airways System, he brings back technical data and information of greatest importance to the program for an American trans-Atlantic air service.

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AVIATION
FOR JANUARY, 1934

The Old Year

The turning point was passed in 1933 and all forces are moving upward

IN the aeronautic annals, 1933 will be remembered as the period immediately following the turning of the tide. With all the major forces moving upward and black ink prevailing over red, there has been a mental change within the industry. The period of hopelessness has been left behind and those who dare to think in terms of expansion have ceased to be objects of scorn.

There has been some variation in the rate of upward movement, with transport forging forward at continuously accelerating tempo and production rising slowly from a low point. And while the industry was struggling to forget the coveted attainments of 1929, the export figures rose to such great height that there was no other period with which to compare them.

The export boom was due at least in part to shifting monetary standards throughout the world, and particularly in the United States where depreciated currency made purchases of our products attractive to foreign buyers. But other changes in the course of the world's history have had beneficial effects upon the industry. More than a decade of discussion has culminated in the virtual collapse of disarmament efforts, and wisdom born of scarcity of resources has caused each nation to seek the most effective and the least expensive medium of defense—the airplane. As the year closes this state of affairs has been reflected mainly in our export market. The much discussed plans to increase our own defenses has gained little headway although allotments have been made of Public Works Administration funds for new aircraft and equipment for the Army and Navy.

Production prospects for next year are enhanced not only by the military and transport demands, but by the possibility of an enlarged private market, toward which the new Administration, through the reorganized Department of Commerce, is directing its efforts. Three constructive steps were taken by Eugene L. Vidal, director of aeronautics, and more will undoubtedly follow. After simplifying the air commerce regulations relating to licenses for private flyers, the aeronautics director broadcast a questionnaire to all licensed pilots to determine the possible market for a low-priced plane if it were available, the price mentioned being in the neighborhood of $700 to $800. (Early returns are recorded on page 25.) The third step was to obtain an allotment of $10,000,000 for the construction of 2,000 airports under the Civil Works Administration.

Sportsman pilot events included the fifth annual Miami air race held in conjunction with the second annual winter cruise of the U. S. Amateur Air Pilots Association in which twenty planes took off from Hicksville, L. I., for Miami and 87 were at the post for the start of the Florida Year-Round Club handicap race from Daytona Beach.

Two codes have been propounded under the National Recovery Act, one for transport and one for manufacturing. The transport code became effective in November while the manufacturing code is still in the process of approval. A preliminary to the preparation of codes was the reorganization of the Aeronautical Chamber of Commerce under the presidency of Thomas A. Morgan, president of the Curtiss-Wright Corporation. Activities of the Chamber are now under the direction of Leighton W. Rogers.

The National air show was omitted in 1933 and, as the year closed, no provision was made for one in 1934. The major air races were divided into two periods of four days each, one, including the July 4 week-end, was held at Los Angeles, the other, including the Labor Day week-end, at Chicago. While the Los Angeles races were in progress an unsanctioned race meet took place in Chicago.

At the annual convention of the National Aeronautic Association during which Hiram Bingham, former Senator from Connecticut, was re-elected president, a resolution was adopted changing the method of selecting state governors who will be elected by ballot of the state organization instead of by delegates at the annual convention.

Transport

As air transport concludes the most brilliant year in its history, in spite of the downward trend of railroad fares through actual reductions, elimination of extra fare, and institution of special excursion rates, most of the railroads have realized that the airlines have come to stay. Following the recommendations of the National Transportation Committee, of which the late Calvin Coolidge was chairman, the railroads, whose traffic has suffered most severely

from airline competition, have been looking about for ways and means of getting into the air transport business The Boston & Maine Railroad took the longest step in this direction in the establishment of Boston & Maine Airways, consisting of part of the personnel and equipment of the old Ludington Line, transplanted to operate between Boston Portland, and Bangor, Me

Air line consolidation during the year included the purchase of Ludington Airlines by Eastern Air Transport, and the subsequent merger of North American Aviation and General Aviation, which cemented the relations of Eastern Air Transport and Transcontinental & Western Air The acquisition of Transamerican and Martz airlines by the Cord interests and their incorporation into American Airways followed closely after the control of American Airways passed into the hands of the Cord group.

Continued government support and continued maintenance and improvement of aids to air navigation were unreservedly recommended in the report of the National Transportation Committee In spite of this need, however, and of the increased demands imposed upon operators by the transport code there has been a continuous downward trend in air mail contract rates made necessary by the reduced appropriation

No hysteria of a frenzied stock market could exceed the vicissitudes of the air mail appropriation during the lame-duck session of Congress. From the $19,000,000 of the previous year the allotment was reduced through several steps to zero only to be restored to the full $19,000,000 and then reduced again to $15,000,000 The actual money finally made available, after further trimming by the Director of the Budget, was about $14,000,000

A compromise course in the relations of the government and the air mail operators was advocated in a bill framed by Congressman Kelly of Pennsylvania

Substitution of the Boeing Model 247 on United Airlines and the Curtiss Condor on American Airways and Eastern Air for some of the older equipment has had an important effect in speeding up schedules At present, United maintains a 19½-hour transcontinental service

Shortly after the first high-speed planes were placed in service, a disagreement regarding basis of payment for pilots, and the variation of pay with speed arose between the operators and certain of the airline pilots On several occasions strikes were threatening Pending the decision of a fact-finding committee of the National Labor Board a new standardized scale was instituted

1 The Vultee V-1 of the Aircraft Development Corporation 2 The Stinson Reliant at the Century of Progress 3. From the field of the International Air Races. 4 Major de Seversky and his record breaking

amphibian 5 Consolidated P2Y-1 for the Navy 6 Waco Model C 1933 edition 7 The 'Argo' appears at the races 8 A low wing pursuit—the Boeing P-26-A. 9 Route of the latest Lindbergh flight in the interest of Pan American Airways 10 Fairchild Amphibian for Pan American Airways. Men of the year—Eugene L. Vidal, new director of aeronautics, Department of Commerce (upper left); Leighton W. Rogers executive vice-president Aeronautical Chamber of Commerce (lower left); Charles A. Lindbergh (upper right) who surveyed the North and South Atlantic ocean routes

Research

While the efforts of research continue to be directed toward increasing maximum speed, the correlative problem of reducing landing speeds has received considerable attention during 1933 The improved facilities of the N A C A laboratories have been devoted very largely to the problem of increasing the speed range of aircraft through reduction of drag at one end and an extensive study of lift increasing devices at the other Balancing tabs on the control surfaces have been the object of study

The investigation of rotating wing systems has turned to consideration of the cyclogiro or paddle-wheel rotor, and computations have been made on the prospective performance of airplanes equipped with this type of lifting surface A systematic study of vision from the pilot's cockpit has been furthered by the development of a new instrument known as the Visiometer, which makes a photographic record of area and range of vision.

An extensive investigation of flutter has been underway at Wright Field (see page 21) A systematic study of a large number of airfoil sections has been made in the variable density wind tunnel at Langley Field

Design

The research of the depression years bore fruit in 1933, and transport and military airplanes were the chief beneficiaries Aircraft for sport and private use underwent some refinement, but their progress was somewhat slower

New transports that are being placed in service on the major airlines combine 150-200 mile cruising speeds with greater passenger comfort and more silence, as well as better maintenance quality, than any of their predecessors

Cantilever monoplanes are the order of the day for transport, with the Curtiss-Wright Condor in America and the Boulton & Paul mailplane in England both biplanes, the exceptions A variety of aerodynamic and mechanical factors promote the twin engine type Trimotored designs were more numerous abroad, undoubtedly because European transport performance generally is not high enough to permit of safe operation with one engine dead on a twin-engined ship In the single engine group were the Northrop, Vultee, and the new Orion

Flying boats of oceangoing cruising range are under way at the Sikorsky and Martin factories for Pan American

Riveted aluminum alloy monocoque construction following recent military rule, has been developed in this country in such designs as the Douglas Northrop, and Boeing but the Condor retains the welded steel tube structure with fabric covering Retractable gears are becoming the rule in transport design Trailing edge flaps usually of the split type are increasingly common

The time-worn practice of stabilizer adjustment in flight has been replaced by the use of control surface tabs controllable from the cockpit on some of the new transports They prove valuable not only for trimming but for control surface balancing Air brakes of the turning strut variety have been installed in the new Waco cabin plane

Part of the increased efficiency of operation can be attributed to the controllable-pitch propeller which reached a high stage of development in 1933 Performance of multi-engined planes with one engine dead has been appreciably improved as well as performance at altitude of all airplanes

Cabins soundproofed to the Pullman-car level of 70-75 decibels and steam heating plants are contributing factors to comfort

Autogiro design has progressed to the stage where application of the principle to aircraft of transport proportions appears to be a not far distant possibility Machines of the Cierva type have been refined and test flights were made in England of an autogiro in which no fixed wing and no rudder were required. Lateral control and steering were accomplished directly from the rotor through a specially designed mechanism The most recent innovation in rotating wing machines is the "cyclogiro" sponsored in this country by Haviland H Platt and in Europe by Dr Rohrbach

Naval aviation

The year 1933 has been an important as well as an exacting one in the history of Naval Aviation The year was marked by unusual and drastic economies and as a result, operations were on a restricted scale

Scouting, torpedo and bombing, observation, and fighting planes were carried on the aircraft carriers Lexington, Saratoga, and Langley, while catapults on battleships and cruisers continued to permit the operation of scouting and observation planes at sea.

Progress on the construction of the Navy's fourth aircraft carrier, the Ranger, has been marked. This vessel was launched on Feb. 25, 1933, and it is expected that she will be commissioned in May, 1934

In lighter-than-air a catastrophe befell the Navy in the loss of the U.S.S. Akron with 73 officers and men, including Rear Admiral William A. Moffett, then Chief of the Bureau of Aeronautics This accident, which occurred on April 4, 1933, is one of the greatest peacetime disasters ever suffered by the Navy The subsequent investigations by a Navy Court of Inquiry and a Joint Congressional Committee showed that the disaster was due to no fault in the design or construction of the airship

In the same month that the Akron was lost, her sister ship, the Macon, was completed and began trial flights. In the middle of October she proceeded to her permanent base at Moffett Field, Sunnyvale, Cal, the Navy's new airship base which was placed in commission on April 12, 1933

Fleet aircraft again participated in all maneuvers and concentrations during the year, operating under all conditions encountered

Air Corps activities

Progress of the Army Air Corps, as summarized in a paper presented by Maj. Clinton C. Howard, chief of the Materiel Division, at the December meeting of the Society of Automotive Engineers, has been impaired by restrictions on expenditure of funds appropriated for the current year It has been the policy to continue the power plant development projects at the expense of other activities

The rating of the Curtiss Conqueror V-1570 has been increased to 675 hp Power of certain radial engines also has been increased, and the double-row engines now have a definite place in the Air Corps program.

Prediction of the point of failure of propeller blades subjected to resonant vibration has been made possible and the noise of propellers has been studied in an attempt to reduce it

For the military types of airplanes the ratio of structural weight to gross weight shows a steady downward trend in spite of the increase in performance

The Martin Bombers, B-10 and B 12, Curtiss A-12 Attack, Douglas O-43 Observation, and Boeing P-26 Pursuit, have passed from the service test classification to standard. In the service test status at present are the Curtiss-Wright YO-40 A and B Observation types, similar in basic design but different structurally. Both are of all metal construction with retracting undercarriages, and powered with the Wright Cyclone engine. The model B is a high wing monoplane with slots, flaps, and cabin enclosure Service test quantities of the Consolidated A-11 are under construction and the YP-30, a development of the P-25, is expected to be ready for service test by the first of the year. A single seat pursuit designated P-29, incorporating cantilever wing and retractable landing gear, is also being brought out for service test

A specification has been drafted for a military transport and development is going forward on an amphibion, a special version of the Y1C-21 (Douglas).

Gliding and soaring

The most outstanding single soaring flight in the U.S.A. in 1933 was the flight of 122½ miles along the Shenandoah ridges by Richard C. duPont from Rock Fish Gap (Va.) to Frederick, Md., on Sept 21. This was a new American distance record. The former American record, held by Jack O'Meara, was 66.6 miles. The world distance record is 136.8 miles, made in Germany The day before duPont's flight Emerson Mehlhose of Pittsburgh flew about 70 miles along the same ridge.

The 1933 National Soaring Contest at Elmira under the auspices of the Soaring Society of America, Inc., the fourth national event held, produced little in the way of performance because of lack of suitable meteorological conditions

New designs in 1933 included the advanced Bowlus models, one of them a two-place sailplane and the two-place utility of the Funk brothers of Akron

The Soaring Society of America, the organization sponsoring soaring activities in America, was admitted to the status, the Internationale Studienkommission fuer den Motorlosen Flug

Flights, competitions, records

The high-speed school at Desenzano Italy, was the scene of two new world speed records, previously held by England. In a Macchi 72 seaplane, powered with 2 Fiat 2,500 hp engines, Warrant Officer Francesco Agello, over a 3-km course on April 10 achieved 423.82 m.p.h. in six laps Another Macchi 72, piloted by Lt Col Cassinelli broke the world's speed record for a 100 kilometer (62 mile) course at 393.33 m.p.h. on Oct. 8.

In the same plane Maj Pietro Scapinelli flew over a triangular closed circuit at an average speed of 384.86 m.p.h. and was temporarily awarded the Bleriot Speed Cup

Jimmy Wedell, in his Wedell-Williams 44 monoplane with 800 hp supercharged Wasp engine, averaged 304.98 m.p.h., and topped Major Doolittle's record by nearly 10 m.p.h.

Col Roscoe Turner set a new west-to-east transcontinental record from Burbank, Cal., to New York, traveling 2,520 miles in ten hours, five minutes.

The Frenchman Gustave Lemoine wrested the world's altitude record for heavier-than-air craft from Capt. Cyril Frank Uwins of England. In a Potez 50 with Gnome-Rhone Mistral Major engine, Lemoine climbed to a height of 44,819 ft., topping the previous record by 843 ft. Highest official ceiling of the year was reached by Lt. Commdr. T. G. W. Settle, U.S.N. and Major Chester L. Fordney of the Marine Corps Their balloon rose to a height of 61,237 ft., 8,037 ft. higher than Professor Piccard's 1932 record Russian balloonists succeeded in attaining 62,300 ft., but, since the U.S.S.R. is not a member of the Federation Aeronautique Internationale, their claim was not officially homologated.

To establish the year's non-stop straight line distance record, the French pilots Codos and Rossi flew 5,657.38 miles From Floyd Bennett Field, N. Y., to Rayak, Syria.

Captain Barbaran and Lieutenant Collar had to their credit the longest westbound North Atlantic flight. When they landed in Camaguey, Cuba, 39 hours, 55 minutes out of Seville, Spain, they had flown more than 4,000 miles. A new England to Australia record of six days, eighteen hours was set by Flight Lt. C. T. P. Ulm in an Avro plane with three Wright Whirlwinds.

The National Air Races at Los Angeles in July opened with the Bendix Trophy Race won by Col. Roscoe Turner who made the 2,500 miles from Floyd Bennett to Los Angeles in eleven hours 30 minutes A record of 180.3 m.p.h. in the new amphibion category was established by Maj Alexander de Seversky in his self-designed SV-I at the National Air Pageant at Roosevelt Field. The Deutsch de la Meurthe Cup Race, European speed classic, was won by M. Detré of France, at 200.7 m.p.h.

From July through December in their Lockheed Sirius seaplane Col. and Mrs. Charles A. Lindbergh were engaged in a survey sponsored by Pan American Airways to study possible overseas routes

Noteworthy among the performances of the year was the 6,100 mile overseas flight of General Balbo's air armada to the Century of Progress at Chicago Another famous visitor to the World's Fair was Commdr. Hugo Eckener in the Graf Zeppelin Six patrol flying boats of the U. S. Navy made two impressive overseas formation flights the first non-stop, from Hampton Roads, Va., to Coco Solo (2,059 miles), the second one-stop, from Coco Solo to Acapulco, Mex (1,250 miles), thence to San Diego (1,648 miles).

Wiley Post completed the first solo flight around the world at a new record time of seven days, eighteen hours, 49½ minutes for the course distance of 15,596 miles

Some Military Achievements

New equipment for the air forces (From top to bottom) The Consolidated Y1P-25 pursuit plane powered with the Curtiss GIV-1570 engine The Martin Bomber, 1933 Collier Trophy winner, in its latest form A cockpit enclosure is employed in the Curtiss YO-40B Observation plane (Cyclone). The commercial influence is obvious in the Northrop attack plane

Airliners of 1933

SPEED combined with a degree of comfort hitherto unknown to air passengers has been the keynote of the transport planes of 1933. The 200-m.p.h. mark, not many years ago the goal of racing plane designers, has been reached and passed in airplanes designed for intensive and efficient transport service. The Northrop Delta (top) and the Douglas DC-1 (extreme left) will soon be in the regular service of Transcontinental & Western Air, and their use will cut the regular coast-to-coast flying time to a new low record. The Curtiss-Wright Condor (bottom of page 6) is already in regular use on the lines of Eastern Air Transport and in the special high-speed services of American Airways. Through the use of the Boeing Model 247 (circle) the present transcontinental flying time has been cut to 19½ hours by United Air Lines.

In Europe a demand for higher speed transports has been met in Holland by the Fokker F XX (above) and by the Dewoitine D-332 (below) in France.

Racers and Record Breakers

Substantial advances were made during 1933 in all principal world records for airplane performance. The landplane speed mark was raised to 304.98 m.p.h. by James R. Wedell in his Wasp-powered Wedell-Williams monoplane (above). The altitude record was wrested from the British by the Frenchman, Gustave Lemoine who attained a height of 44,819.41 ft. in the special Potez Type 50, powered with a Gnome-Rhone 14 Kbrs engine (center). Italy is the present holder of the world seaplane speed record of 423.82 m.p.h., established by Sergeant Major Francesco Agello in a Macchi 72 seaplane powered by a Fiat A.S.6 engine developing 2900 hp. at 3000 r.p.m. (below).

Looking Around the Corner

Lifting the Veil on the Industry's Prospects for 1934

By *Edward P. Warner*
Editor of AVIATION

THE BUSINESS of prophecy would be much simpler and more straightforward if tradition did not demand that it be wrapped in such elaborate trappings. It needs debunking, and I always solemnly remind myself, when I set about these annual ventures in forecasting, of the Scottish golf professional who was asked by an afflicted amateur for the secret of the drive that was long and true. "Weel," said the expert, "it's lik' this, I tak' the club in my han's, I stan' up to the ba', and I gi'e it a guid thwack."

Prophesying for the aircraft industry ought to be just as simple as that. You know where you have been; that is the past. You take a firm stand where you are now; that is the present. And then you look about you, and especially ahead of you, and tell what is plainly to be seen, and that is a prophecy of the future.

Unfortunately the visibility is sometimes low and the field of view filled with the most unaccountable mirages, and there is so much to see that the eye cannot take it in as a whole and all at once. Making an industrial forecast is like designing a bridge; you cannot simply draw the thing as a whole, nor can you consider all at once and all together all of the loads to which it is to be subjected. You must break them up into various arrangements, a certain dead weight of the bridge itself, a certain live load of moving vehicles distributed in various specified fashions, and a certain wind load against the side of the structure. Then you must analyze the effect of each load separately upon each member of the bridge and add all their effects together, and so you will secure the data for proportioning each member to be strong enough to carry its share.

Just so when we attempt to foresee what is to happen next in aviation. If we try to take account of everything at the same time we merely grow confused. But if we break each question down into its parts, and study each part separately, we can determine the effect of each one separately and then add them all together to get the effect of the whole.

How to forecast

We know, for example, that a certain number of people have flown on American airlines in 1933. If we want to know (and certainly the operators of the airlines would very much like to) how many will make use of the service in 1934, we can take this year's record as the starting point and write down in one column all of the things that would tend to increase the patronage, in another all the things that might tend to decrease it, with an estimate of the number of passengers likely to be affected each way by each item. Then put them all together, and there is our answer. At best it becomes a simple arithmetical problem, and if we get the wrong answer it is because we have omitted some of the factors or have not fully understood the effect of some of those that we have taken into account. At best, prophecy ceases to be a form of witchcraft and becomes a form of mathematics. The art has been mechanized. The less imagination the prophet has the better, and in absolute perfection he would be a sort of statistical assembling-machine, with a collection of facts and prospective influences fed in at one end and a neatly-packaged portrayal of their ultimate combined results turned out at the other.

Whatever method we may use, whether this simple mathematical one or a combination of astrology and the reading of tea-leaves, aviation always provides us with plenty of subjects upon which to practice. There is a particularly lavish supply of invitations to experimental prediction at this time of year. Jan. 1 is the time for hanging new calendars on the wall, for making new resolutions and for setting up new plans, projects and budgets in industry. New plans always involve a guess at what is going to be going on around us in the future. We can't decide whether or not to buy new equipment for a school until we know how many new students are likely to be available. We can't decide what kind of an airplane to produce next year until we know something about the relative demand that will be shown for various types of craft. The air is full of question marks, some large, some small, some sharply defined, some vague.

The most important questions are those that affect the most important division of the industry, and about where that is there can be *no* question. Whether the rating be made in terms

"The less imagination the prophet has the better, and in absolute perfection he would be a sort of statistical assembling-machine with a collection of facts and prospective influences fed in at one end and a neatly-packaged portrayal of their ultimate combined results turned out at the other."

of annual revenue, or of personnel employed, or of interest displayed by the public, or in almost any other terms, air transport is moving steadily out ahead of every other aeronautical activity. Passenger revenues on American airlines for 1933 will be better than $11,000,000; passengers, mails and express together will bring in approximately $36,000,000 for the year. The total passenger traffic will probably be over 190,000,000 passenger-miles, 30 per cent above last year's figure and about 9 per cent better than was prophesied in these pages a year ago,—when not enough account was taken of the beneficent influence of the Century of Prog

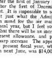
ress? Now, what can we expect for 1934.

Good news for transport

In 1934 Chicago's Century of Progress will still be with us. New equipment will provide a substantially improved service on some 25 per cent of the nation's transport routes in addition to the sections that have already been modernized in 1933. We may look forward with high hopes, if not with absolute confidence, to an improvement in general business conditions and to business men having a larger amount of money to spend on travel. The habit of traveling by air and the inclination to take the airplane whenever possible have been spreading and will continue to spread. All that is on the credit side of the ledger.

On the other side there are but two items, and both of them are purely economic. First and most serious is the cut in compensation for carrying the air mail. The average rate of mail pay is now down to about 35 cents per mile, a drop of almost 40 per cent in one year. The total amount of money available for payment to domestic airlines has been reduced by approximately a third from the level of a year ago. Unless at least a part of that cut is restored it is going to be impossible for many of the transport lines to maintain their present service, and certainly it will be impossible for them to continue to spend money on experiments and on the development and purchase of new and improved equipment with the freedom that has been the general rule.

This may be a good point at which to introduce my first definite prophecy. Under the new organization of Congress, the Federal budget will appear just after the first of January instead of just after the first of December as in the past. It is impossible to say at this moment just what the Administration have in mind for the air mail for the next fiscal year, but I feel some confidence that there will be an increase over the present allowance, and perhaps a very sharp increase. The appropriation for the present fiscal year, which runs through next June, was $14,000,000 for



"Prophesying on air transport is always a pleasant undertaking because the curves always point upward."

"Whatever the railroads may do in the way of speeding up, their cruising speed is still sure to be well under half that of the airplane."

domestic air mail. For next year I am inclined to believe it will be around $17,000,000, and upon that basis it should be possible to continue all of the services now existing, though not to extend them. There is at least a possibility that Congress will allow and that the President will approve allotting $19,000,000 or more, and it would then be possible not only to maintain service, but to open new routes.

The second debit factor that has to be taken into account is railroad competition. It remains to be seen how much the spectacular "streamlined trains" are going to amount to, or how fast a schedule will really prove to be possible after they are in service. Whatever the railroads may do in the way of speeding up, their cruising speed is still sure to be well under half that of the airplane. The really competitive problem is not concerned with speed, but with rates of fare, and now the railroads are stepping out with a policy of rate reduction, and the indication is that the average fare for Pullman travel will be lowered in the very near future from around 5½ cents an airline-mile to something in the neighborhood of 4 cents. The airlines have many thousands of patrons who are so firmly wedded to air transport that they will be willing to pay a much larger differential of fare than now exists in order to avoid railroad travel, but there is no doubt that lowered railroad rates will detach a certain proportion of the air travelers from their allegiance and get them back onto the surface.

Now we can take all these factors and put them together and see where they leave us. The total passenger travel on American airlines, domestic and foreign, will be about 190,000,000 passenger-miles in 1933. I estimate a traffic, on the assumption that Administration policy provides generously enough for the air mail so that all of the present mail routes can be kept in service and with the present number of schedules of 240,000,000 passenger-miles for 1934, —a gain of more than a quarter over

the present year. That will provide an average load of between four and five passengers for every plane on which passengers are carried,—an average load factor, for the whole American air transport system, of almost 50 per cent.

How much flying?

Traffic is more important than the distance that must be flown to get it, but the total plane mileage of the year is still a very significant item in the planning of the transport operator. For the present year the total is likely to be about 54,000,000 miles, and the mail routes on which contracts are now outstanding call for a present scheduled mileage of mail of 112,950 miles a day, or 39,000,000 per year allowing for the customary amount of mileage cancelled on account of weather. Extra sections may add 2,800,000 miles, and non-mail services by holder of mail contracts another 8,500,000. During the present year the total mileage of the non-mail companies has been about 4,000 000. On the basis of a domestic air mail appropriation of $17,000,000 for next year, and a continuation of the foreign mail appropriation at the present level of $7,000,-000, I predict a total mileage in 1934 of 39,000,000 with mail and 15,500,000 without, or 54,500,000 miles in all,—a slight improvement over 1933. If the domestic air mail appropriation for the fiscal year 1935, beginning next July, should be boosted to $20,000,000 the total mileage flown ought to be up to 58,000,-000 and in that case I should expect to see the passenger mileage rise to around 260,000,000 and the passenger revenue to $15,000,000.

Air express is much less important in its contribution to transport revenues than either mail or passengers, and I believe that it will continue to play a very subordinate part, but still it is far from negligible. If the air mail rate should be reduced the mail service will cut into the express traffic to some extent on light parcels traveling over long distances. Taking account of that effect, I look for another 15 per cent gain next year bringing the total poundage up to 1,900,000. The total revenue ought to amount to about $850,000,—about 2 per cent of the total income from all sources.

Pilots and students

Prophesying on air transport is always a pleasant undertaking because the curves always point upward. Prophesying on miscellaneous flying operations and on licensed pilots and the like has not always called for quite so much optimism, or if the optimism has been there it has sometimes proved to be misplaced. The number of new student permits issued has been falling off steadily from year to year, and the number of pilot licenses outstanding has made but little gain, the cancellations almost equalling the new additions. In 1933

some 10,300 student permits have been issued. For next year I anticipate a sharp increase in that number. The obvious determination of the Department of Commerce officials to stimulate private flying by all possible means, the increased wages that many young men will be receiving, and the increased leisure that they will have after their newly-shortened hours of work as a result of NRA activities, will combine to make a great many of them at least get themselves into a position where they can legally take advantage of any opportunity to learn to fly. Though the number of permits issued throughout 1933 is about 10 per cent below the number for 1932, the rate at which new ones were being put out in October and November ran about 20 per cent ahead of the figure for the same period of the preceding

"This year the military expenditures must be the subject of prophecy instead of simple statement."

year. For next year I expect to see the number of permits around 13,000, and if the Department of Commerce should finally decide to simplify the medical requirements for students so that the student can at least consult his own physician and will not have to meet specifications any more severe than those, for example, of Great Britain, the number of new permits ought to get up at least to 16,000. The imposition of the elaborate ritual of a special medical examination given only at the office of a specially-approved physician has certainly been responsible for a substantial decrease in the number of new permits and in the actual number of flying students in the past few years. Some very competent students of the subject believe that a change of the medical rules, with no real lowering of the standards but a mere slackening of the formalities, would double the number of applications for permits. I shall be conservative and estimate that it would increase the number by only 25 per cent.

Of the 13,000 students that I anticipate if there is no change in the medical rules a considerable number will of course be present holders of permits, getting the permits renewed because they have not yet qualified for pilot licenses. I believe that about half of them will be newcomers seriously intending to take up the study of flying, that a majority of that number will take instruction privately with friends or not get around to taking it at all, and that there will be about 2,000 new enrollments in regular flying schools. The number of active pilot licenses at the end of the year ought to be around 17,000, including about 7,800 holders of transport licenses. That will be fewer licenses than were outstanding a year ago, but in the meantime the minimum of hours for the lowest grade of license has been raised from 10 to 25.

While I talk about schools and the training of pilots, the training of mechanics also ought to come in for comment. The number of licensed mechanics has been amazingly stabilized over the past years, always between 8,000 and 9,200 since the beginning of 1930 and standing now at about 8,250. If the Department of Commerce carries through with its drive to develop private ownership, to encourage building of low-priced planes, and especially to develop new airports which will have to have service facilities of some sort, we are likely to find a positive shortage of mechanics with really good qualifications, qualified to take on a job on their own instead of merely working under direction. I am not bold enough to attempt to predict the number of students that will enroll in mechanics' schools within the next year, or any other period. There is too little background of known facts for such a prediction, but at least I can foretell the probability assuming a slight improvement in business and a continuation of the Aeronautics Branch on anything like its present course, of more employment for the graduates of mechanics' schools than has been available for several years past.

Work for the factories

In looking at aircraft production it has been the rule for several years that most of our attention must be fixed on the Army and Navy. In 1933, as in the two preceding years, approximately two-thirds of the total output of the industry went into the military services. As a general rule we know by the first of January almost exactly the amount of money that will be spent for new planes for the Air Corps and for the Navy during the ensuing year, but this year, unfortunately, the military expenditures must be the subject of prophecy instead of simple statement. The intertwining of the regular and the extraordinary budgets and the uncertainty about what will be allowed from Public Works funds have resulted in the industry's being uncertain even from day to day about what the services will be able to do in the way of buying new equipment. Virtually the entire ap-

propriations for that purpose for the present fiscal year have been sequestrated by order of the President and have then been partially replaced by Public Works allotments. With the $3,300 000,000 that was originally appropriated for the public works program almost entirely allotted, and with a strong probability confronting us that the $1,500 000,000 or thereabouts which is likely to be added at the next session of Congress will be earmarked for specific projects, we may at least expect much less vagueness about what the Army and Navy are going to be able to spend during the latter part of 1934 than has marked the last months of 1933. When the President presents his budget to Congress in the first week in January, that matter and many others will be more or less completely cleared up, but it would be very surprising if there were to be any reduction in the allowance for air force. Without attempting to set an exact figure, since we shall have the official figures available within a couple of weeks, I suggest at least the strong probability that the amount of money for new military aircraft will be returned at least to the pre-depression level of around $30,000,-000 a year. Anything less than that would seem definitely surprising under present conditions.

It will have been observed that the course to be taken by the Federal Gov-

"The imposition of the elaborate ritual of a special medical examination given only at the office of a specially-approved physician has certainly been responsible for a substantial decrease in the number of new permits and in the actual number of flying students in the past few years."

ernment is the great x in every aeronautical equation at the present time. If I were to be given the task of editing the 1934 edition of the Young Prophet's Guide and Soothsayer's Handbook, on the strength of my three years of essayed prediction of aviation's prospects, I should start the book with an injunction in type so large and black that it could not be overlooked: Look first to Washington! The Federal Government has always had the whip hand over aviation's affairs to a large degree. Now it is controlling the destinies of all industries, and its influence upon

aviation's immediate future is more intimate and complete than ever before The mileage to be flown in air transport depends upon the policy of the Post Office The number of passengers that will be carried depends to a considerable extent on what the Federal Co-ordinator of Transportation incites the railroads to do to their fare structures by way of meeting airline competition The operating expenses, both of airlines and of manufacturers, depend on the NRA. The business gotten from military aircraft depends on the budgetary policy of the Administration and upon the position that it plans to take in international affairs, and the course of the market for private aircraft is going to be very largely governed by the particular measures that the Department of Commerce decides to take in the next few months to develop private ownership

Vidal sets the pace

The history of private ownership over the next couple of years is going to be written largely in terms of reaction to the policies of Director Vidal, including the $700 airplane and the construction of a host of new airports at federal expense At the present time there are about 6,000 licensed civil aircraft in the United States, not including those owned by the transport companies Replacement business alone ought to account for about 150 to 200 small cabin machines, from 50 to 100 open-cockpit types, and some 30 planes of six-passenger capacity or more On top of that, neglecting Vidal's low-priced airplane plans entirely and assuming for the moment that they will come to nothing whatever, there should be a private ownership market for about 200 new planes, approximately equally distributed between the cabin and open types, the latter mostly of the low-priced light class I am making no allowance for new purchases for school and flying service use Of course there will be a certain consumption in those quarters, but under present conditions the demands of the flying services for new equipment are likely to be met quite largely from the used-plane market

It seems absurd to talk of a replacement demand of only 280 planes where 6,000 machines are in service, but very few of the 6,000 are more then four years old, and the replacement curve is distorted in consequence Even if private operation were to continue strictly on the present level the annual demand for pure replacement purposes would increase gradually until it reached around 1,000 planes a year in 1936 or 1937

All of the foregoing figures relate to domestic consumption Beyond that there is the export market, and for 1934 the exports, not including shipments abroad for the use of American airlines operating internationally, ought to amount to about 200 planes Of that number perhaps three-quarters will be military, most of the rest of the small cabin type

New planes for airlines

Next come the transports As I have already noted in predicting transport activity, it is probable that about a third of the airway mileage will be re-equipped with new ships during 1934 The machines now in use on the services likely to be re-equipped, or at least owned by the companies operating those routes, number about 160, but in putting on new airplanes of standardized type one new plane is about equal to two old ones, and the new transport deliveries for 1934 will probably be around 110,—all of them of course planes of six-passenger capacity or more, and a majority accommodating ten or more

Adding all these items together the outlook seems to be for a total production, excluding ships built for the American Army and Navy, of 890 planes,—about 40 per cent ahead of the year just ending Over a third of the total number should be cabin planes of two to five-passenger capacity Among the remainder I allow for about 140 ships of transport type and about 80 open-cockpit planes selling at under $3,000 The total value of the year's production of American aircraft and engine factories should run to about $4,500,000 for American transport lines, about $5,500,000 for export, and about $3,200 000 for American private and industrial-owner flying services, a total of $13,200,000 in addition to the $30,000,000 (or whatever it may prove to be) that the Administration and Congress may finally decide to allow for military purposes. Both civil and military production should run, in dollar value, ahead of either of the last two years.

Let me emphasize again that all this predicting on production has been carried forward totally without reference to Director Vidal's scheme. Taking account of the length of time that is required to get a new low-priced machine in production on a large scale, or certainly to get through the experimental stages to the point where it would be safe to start building it in any such number of planes as 10,000, it seems unlikely on the most optimistic assumption that development along this line will have much effect on the market for 1934 If a plane selling at $1,000 or less *should* appear, however, whatever sales may be made of that type can be added to the production estimates that have already been given for the existing types And here we come, as the closing feature of the forecast, to a very important bit of forecasting indeed,—the estimate of the market that would really exist under present conditions for an airplane of the type that Mr Vidal has described

The estimated performance of the plane described in the Vidal questionnaire is not so very different from that of the best light planes that were put on the market in 1931 In that year it was widely believed in the industry that sales of the new low-powered ships would run to at least 3,000, and perhaps to twice that. The actual figure for 1931 proved to be something under 500 That is the *first* fact to bear in mind Another fact, pointing in the opposite direction, is that the percentage of replies to the Vidal questionnaire proved astonishingly high, returns being made by almost a half of all those receiving the paper, and that about 9,000 of the 16,000 making prompt response said that they would buy such a machine as Mr. Vidal had described for themselves, and that they knew other people who would buy also, —"other people" to a total number, making no allowance for duplications, of over 38,000 That looks very encouraging,—much more so than experiences in the mass selling of airplanes in the past would have led us to expect, though to be sure the experiences of the past do not exactly apply to the present plan.

Puzzling over these facts and others, I come to the personal conclusion that if a really sound two passenger airplane, factory built and well finished and with nothing shoddy about it, with its design representing the best that aeronautical engineering can now produce in the way of safety and reliability and efficiency and simplicity, could be built to sell for $700, there are about 200 000 people in the United States who would be logical prospects for its purchase. That is to say, there are about that many who are so fixed financially that they could afford to buy and maintain such a plane. Of that number I believe that about 2 per cent (three-fifths of them already holders of pilot licenses or permits) might be persuaded to buy if the offering of the new plane were well enough staged and if the selling campaign were planned with sufficient skill To the 4,000 customers so calculated it would be necessary to add about another 3,000 (almost all of them among the recipients of the Vidal questionnaire) who couldn't really afford to operate a plane as a regular thing under present conditions, but who would be so eager to get hold of a ship of their own on some terms that they would scrape up the money for a purchase somehow and fly the plane for a while before shortage of funds would force them to pass it along to another purchaser The total of first-years prospects for such machines looks to me like about 7 000, or not very far short of Mr Vidal's original estimate, but to my forecast on that point I have attached a number of *ifs* which must be read along with the final figure. Upon that somewhat vague and therefore somewhat unsatisfactory note I suspend prophecy, to await verification or rebuke by the actual course of events as the leaves from January to December flutter off the calendar

The results of 50 hours of flight testing, involving 12,000 engine temperature readings, to determine the cooling properties of several forms of cowling

Cowling and Cooling

By Otto E. Kirchner

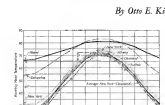


Fig. 1 Average temperature for the Cleveland-Brownsville (Tex.) belt The curve for Miami corresponds to that for Brownsville.

THE DESIGN of cowling for aircraft air-cooled engines is still very much a cut and try process. The essential qualities, however, are adequate dissipation of the heat from the head and barrels of the engine cylinders, and low aerodynamic drag

Responsibility for cowling design has been vested in the aircraft manufacturer, although there is a rising feeling that the engine manufacturer should include it as a part of his development program The present compromise takes the form of close co-operation between engine and aircraft manufacturer during airplane design The latter will never be able to divest himself of the entire responsibility since it ties in so closely with the rest of the aerodynamic properties of the airplane. At the present time each cowl for a particular airplane is a special problem and must be studied as such. In designs involving center and outboard engines there are sometimes two separate problems.

In design the requirements of the engine must be given primary consideration, the aerodynamic qualities must give way until satisfactory engine operation is obtained. Satisfactory engine operating conditions are associated mainly with cooling to hold cylinder head and base temperatures below maximums recommended by the engine manufacturer Since efforts to lower cylinder head and base temperatures in general tax the aerodynamic efficiency of the cowling, the airplane manufacturer attempts to design for adequate cooling and no more, otherwise the airplane's performance is appreciably affected Complicated cowling also adds to engine and airplane maintenance problems

In manufacturer's flight tests of various types of cowlings there is one factor which has not been given sufficient consideration This is the variation of engine temperatures with air temperatures, although marginal allowance is made for it. Since difficulties continue to arise, however, we are led to believe that the present knowledge is inadequate

Recently this relationship, or "temperature gradient," was the object of a series of tests involving 50 hours of flight and 12,000 individual readings Without the application of this temperature gradient, the results obtained from flight tests may prove incomplete when made only at one station for one set of atmospheric temperature conditions and satisfactory engine operation may suffer because of insufficient margin for year-around operation

In determining a temperature gradient it is essential that a large range of air temperatures be used, so that it is possible to extrapolate the gradient to temperatures not reached in the tests An investigation of the general average temperature conditions of this country, at stations where it was possible to fly the airplane, at the time these tests were considered, indicated a possible maximum temperature difference of 40 deg F (Fig 1) The low temperature tests were made at Cleveland, the high temperature tests at Brownsville, Tex., and varying temperature tests during the cross country flight between the two stations Brownsville having temperature conditions similar to those of Miami, was selected because of its airplane servicing facilities

The tests were made on a Stinson Model "U" Tri-Motor equipped with Lycoming R-680 BA engines

Description of tests

1 *Preliminary*—To ascertain the conditions producing highest engine temperatures likely to be encountered in airline operation, several preliminary flight tests were made These consisted of

(A) Climb tests at various speeds and altitudes to determine air speed for maximum rate of climb at approximately full load

(B) Effect of throttle position in climb and level flight (1) Full throttle, propellers set for 2,050 r.p.m (2) Throttle set to give 1,850 r.p.m level flight. (3) Throttle set at carburetor economizer opening

(C) Effect of carburetor heater in climb and level flight In these preliminary flights, the special instrument installation and operation was checked (Fig 2).

2 *Development of Standard Test Technique*—To facilitate the rapid taking of readings and to obtain a set of test conditions simulating the extreme conditions of airline operations, test procedure was standardized as follows:

(A) The engines were warmed up thoroughly by fifteen to twenty minutes of flight at cruising r p m., after which a landing was made.

(B) The airplane was then taken off

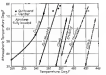


Fig 3. Cylinder head temperatures were found to vary directly 0.44 deg F for each degree of change in atmospheric temperature.

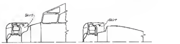


Fig 2. Cowl arrangement for center and outboard engines

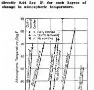


Fig. 4. Variation of cylinder head temperatures with different cowling arrangements. Cowling efficiency is increased by skirts.

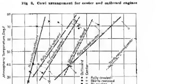


Fig 5. Do cylinders cool too rapidly in glides? The curves show the behavior of cylinder head temperatures in glides with various types of cowlings.

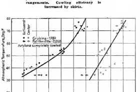


Fig 7. Wide differences were found between center and outboard engines in cylinder base temperatures.

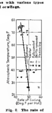


Fig. 6 The rate of cooling in degrees F. per minute in a 1,333 ft per minute glide for a five-minute period

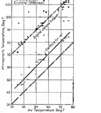


Fig 9 Laying out the air intake ducts. When the intake passes through the engine compartment, insulation should be used. Curves show the variation of engine compartment and carburetor air temperatures.

and kept in the speed of best climb, with throttle wide open. During this climb, consecutive sets of temperature readings were taken on all cylinder heads as rapidly as possible, a complete set of 27 readings plus observation of time, altitude and outside air temperatures requiring about one minute and 40 seconds. The climb was maintained until such time as a decided drop in head temperatures was noted. This usually occurs after approximately 6,000 ft. of altitude has been reached.

(C) The throttle was then completely closed and a glide commenced, losing altitude at the rate of approximately 1,000 ft. per minute. As the airplane descended through the range from 3,000 ft. to 2,000 ft. altitude, a complete set of temperature readings as above was taken in order to determine whether the cooling range of the engines differs with different arrangements of cowling

(D) The throttle was then opened to an average of 1,850 r.p.m. and the airplane flown level at 2,000 ft. (This altitude varied due to limitations in available ceiling.) This flight condition was maintained until all temperatures were stabilized when a complete set of instrument readings were taken.

(E) The throttle was then fully opened, and the altitude of 2,000 ft.

maintained until temperatures again became stabilized. A full set of instrument readings were then taken

(F) The throttle was then closed to the economizer opening position and the altitude of 2,000 ft. maintained until temperatures again became stabilized. A full set of instrument readings were then taken.

(G) A climb at speed of maximum climb was then commenced from 2,000 ft. with throttles in the economizer opening position. Procedure followed, as under B above

(H) The airplane was landed.

(I) For the purpose of establishing average results and as a method of checking readings, this standard test was repeated.

Note—The first few tests demonstrated that items Nos. F and G above were unnecessary, as they did not produce undesirable temperatures and they were then eliminated from this particular investigation.

3. Temperature Tests at Cleveland (Jan. 10 to Jan. 14)—The series of temperature tests carried on at Cleveland consisted of the above test procedure conducted with each of the following cowl arrangements:

(A) With engines cowled.

(B) With engines cowled less inner skirt (Fig 4).

(C) With all cowling removed excepting the spinner covering the thrust bearing housing.

4. Temperature Tests at Brownsville (Jan. 17 to Jan. 19)—The same tests conducted at Cleveland were duplicated at Brownsville, with the exception that in Test 3B, inner skirt was not removed from center engine cowling

5. Tests on Cross-Country Flights—On the cross-country flight from Cleveland to Brownsville, with all engines completely cowled, a complete set of instrument readings was taken approximately every fifteen minutes as flight conditions permitted. These tests were continued on the return trip from Brownsville to Little Rock, Ark

Test results

1. Full throttle climbing flight produced the highest cylinder head temperatures with full throttle horizontal flight next in order. The cylinder head temperatures for cruising (75 per cent total power output) were in all instances lower than those of full throttle climb and full throttle horizontal flight for all atmospheric temperatures

With the center and outboard engines fully cowled the cylinder head temperatures were found to vary directly .44 deg for each degree change in atmospheric temperature (Fig 3). It is interesting to note that this temperature gradient is the same for both the center and outboard engine cowling arrangements, although they have some design differences at the rear of the cowl (Fig 4). An investigation of Fig 3 will show that there is approximately a 48 deg. F. difference in the absolute values of the two curves for the climb condition. This difference is caused by the interference factors in rear of the main engine cowling.

We shall not concern ourselves with a determination of the "temperature gradient" for the full or partial throttle level flight conditions since the separation between the curves is sufficient to preclude the possibility of their intersection at any point in the practical range of operating atmospheric temperature conditions.

2. Note the effect on cylinder head temperatures of changes in cowling arrangement. Fig 5 shows the effects on cylinder head temperatures of a removal of the cowling or inner cowling skirts. At this point it is well to stress the importance of the effect of the cowling skirts on the cooling of the engines. For this particular installation the skirts increased the efficiency of the cowling by 30 to 40 deg. The lack of this temperature difference may be sufficient, under severe atmospheric conditions, to cause engine difficulties which may lead to failure.

Sometimes in the field there is a tendency to make changes in the cowling installed at the factory. Such changes made without a complete temperature investigation and without the approval of the airplane manufacturer frequently lead to serious difficulties.

3. There is some speculation as to the rate of cooling of engine cylinders at the ends of glides. Difficulties have been attributed to engines cooling too rapidly during a glide-in to landing. The tests made in this investigation do not indicate any excessively rapid cooling of cylinders (Fig 6), although there is a slight increase in cooling rate at the lower tempertures. Rate of cooling is not very much affected by cowling arrangements. There is an indication of trends, but tests points are not available in sufficient numbers for definite separation of groups based on cowling arrangement. The glides were held to 1,000 ft. per minute with the throttle closed for the entire glide period (Fig 7).

4. Temperatures of the cylinder bases are also effected by the type of design to the rear of the engine. Differences in the order of 30 to 50 deg were found between the center and outboard engines (Fig 8). Readings were not taken during climb, and very little difference seems to exist between base temperatures at full or partial throttle level flight. At low temperatures the data is somewhat inconsistent, but for the higher atmospheric temperature ranges the temperature gradient is approximately 60 deg.

5. The engine temperatures at full throttle decrease with the use of the carburetor heater, while an increase was observed at cruising speeds. At first this seemed contradictory, but, on analysis, was found to be quite consistent. At full throttle with the use of the carburetor heater the volumetric efficiency of the engine was reduced, which resulted in a lower maximum power output. The reduction in power output reduced the engine temperatures. It also reduced the full throttle r.p.m by approximately 25. To hold constant cruising speed and use the carburetor heater it is necessary, because of a lower volumetric efficiency of the engine, to open the throttle further to obtain the same power output at the propellers. Similar power outputs but lower volumetric efficiency denotes higher temperatures as determined in the tests.

The use of the carburetor heater is being discouraged except for warming up and for the prevention of ice formation in the carburetor. Its use otherwise increases fuel consumption. Incidentally, in checking maximum r.p.m. settings of propellers, with carburetor heaters on the engines, allowance should be made for the drop in r.p.m.

6. In addition to measuring the cylinder head and base temperatures of each cylinder on each of the three engines, simultaneous readings were taken of the oil pressure, oil well temperatures, oil sump temperatures, carburetor air temperatures, outside air temperatures and engine compartment temperatures. The readings showed a tendency to vary in the same direction as the atmospheric temperatures.

Details of engine installation which can only be determined from a complete series of tests were noted in the investigation. Preliminary tests indicated high carburetor air temperatures on the center motor. Investigation disclosed the entrance of air from the engine compartment due to insufficient length of air intake. Lengthening the air intake corrected this objection. The temperature in the engine compartment was found to be consistently about 40 deg higher than that of the outside air. Since the carburetor air intake duct passed through the engine compartment the carburetor air was increased approximately 10 deg. F. on reaching the carburetor (Fig 9). Airplane designers should bear this fact in mind in laying out air intakes. In installations requiring long air ducts running through the engine compartment, the performance of the power plant may be seriously impeded in very hot weather because of this temperature difference. In such instances the part of the air duct through the engine compartment should be insulated.

The use of an interphone system proved to be extremely valuable in taking the readings. The method is highly recommended for tests of similar nature.

Progress in material development is gradual, but each forward step opens the way to a vast field of possible accomplishments for the designer. The advances that have been made in the basic relations of strength and weight, as well as other physical properties, have contributed to the efficient structures and remarkable performance of the most recent airplanes.

Materials . . . Their Effect on Design

By J. B. Johnson

Chief, Material Branch, Materiel Division, U. S Army Air Corps

THE interdependence of airplane design and materials and their mutual effect on performance has been amply demonstrated in the past year Anyone making either a cursory or detailed inspection of the new civil or military airplanea is immediately aware of the advance made in the application of the various materials.

The wooden wing frames and the welded tube fuselages covered with doped fabric do not meet the requirements demanded of the structure of an airplane capable of the higher speeds of modern aircraft, although they are perfectly satisfactory for lower speeds The attempts to save the fabric covered wing by reducing the spacing between the ribs and the pitch of the lacing cord were futile Plywood acted as a stop gap but screws and nails are not very satisfactory under vibration and deterioration is rapid when the airplane is subjected to weathering The designer naturally turned to metal with its greater inherent strength, rigidity, and durability

The application of metal to the construction of airplanes is still in the exploratory stage Combinations of metal and fabric which are used to a limited extent are an anachronism but are sometimes necessary to dampen vibration Different methods of construction are being tried Sheet and tubes are formed and fastened together into innumerable combinations Some are undoubtedly more efficient and economical than others, but it will require time and service tests to determine the most suitable. Extruded shapes which have been used so admirably with the construction of light weight railroad equipment have not been adopted by airplane designers to any great extent

Aluminum alloys dominate the field Competitive materials have so far acted as a stimulus to the research staff of the Aluminum Company of America to cause them to develop new alloys with properties which make it difficult to choose any other material When another choice is made it is generally on the basis of greater ease in fabrication, corrosion resistance, or some special property, but not on account of the basic strength-weight relationship as applied to structural design A new structural alloy which is coming into general use bears the designation 24S It is a duralumin type with an addition of approximately 1 per cent magnesium, which changes the soluble constituent in the alloy so that a lower heat treatment temperature is required and the physical properties are improved The Air Corps specifications for sheet are compared

	Duralumin (17S) Air Corps Spec 57-152-3	Super-Duralumin (24S) 11086
Tensile strength (lb /sq in)	55 000	62,000
Yield strength (lb./sq in.)	30 000	40 000
Elongation 2 in. (per cent)	15—18	15—10

The new alloy can be fabricated without difficulty in the same manner as duralumin Corrosion resistance as determined in salt spray and by alternate dipping in a 20 per cent salt solution and drying in air is equivalent to duralumin. Rivets made of 24S can be headed over after quenching and have a higher shearing strength than 17S The higher yield strength is favorable for short columns. A conservative value for the bearing strength is 90,000 lb /sq in compared to 75 000 lb /sq in for duralumin The alloy in sheet form can be cold rolled after heat treatment effecting an increase in the tensile strength and yield strength to 65,000 and 50,000 lb /sq in respectively The substitution of the super-alloy for duralumin in many cases has permitted the use of material one gage thinner

Castings or forgings?

Heat treated aluminum alloy castings although still used are being replaced by forgings (Fig 1) where resistance to impact and vibration is of primary importance A comparison of the physical characteristics indicates the superiority of the forging The development of methods for manufacturing cheaper dies has permitted the use of forgings even for limited production.

	Casting	Forging
Tensile strength (lb./sq in.)	32 000	55 000
Yield strength (lb./sq in.)	18 000	30,000
Elongation 2 in. (per cent)	3	18
Charpy Impact (ft /lb)	4	12
Fatigue Limit (lb./sq in.)	7,000	11,000

There has been some application of die castings of aluminum alloy for parts which are produced in quantity and which are not subjected to high stresses No die casting is free from blow-holes and their use will be restricted to low stressed parts, mainly accessories, as long as this condition exists

Magnesium alloys in spite of their favorable strength weight ratio have not been extensively used on account of the lack of resistance to corrosion by salt water and tetra-ethyl lead. Magnesium castings are being used for wheels where the service does not involve exposure to a salt water Protective coatings are being developed which may solve this difficulty, but it

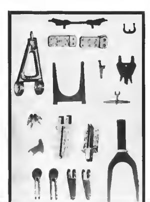


Fig 2 (left) A group of typical heat treated steel forgings.

Fig 3 (above) More liberal fillets and smoother lines are obtained by substituting steel forgings for built up welded types This is shown in the comparison of the welded and forged fittings of two tail skids

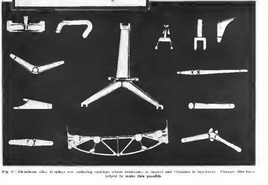


Fig 1 Aluminum alloy forgings are replacing castings where resistance to impact and vibration is important Cheaper dies have helped to make this possible

will require rigorous service tests to determine whether or not they are satisfactory The improvement in magnesium forgings has been quite pronounced. The following table indicates the properties of large forgings of American manufacture tested in 1931 and in 1933 at Wright Field.

	Magnesium Forgings	
	1931	1933
Tensile strength (lb./sq. in.)	35 000	44 000
Yield strength (lb./sq. in.)	15 000	26,000
Elongation 2 in (per cent)	6	9
Fatigue limit (lb./sq. in.)	10 000	14 000

The field for magnesium forgings appears promising for propellers, engine parts, and airplane parts which can be protected from severe exposure Welded magnesium tanks have given quite satisfactory service in Europe but due to the almost universal use of tetra-ethyl lead as a constituent of gasoline in this country, magnesium tanks cannot be recommended since they are corroded by this organic compound.

Stainless steel

Corrosion resistant steel has not been applied as extensively as was freely predicted when the E. G. Budd Company were reproducing the Italian flying boat from spot welded 18 8 strip. Further development seems to be awaiting the results of experimental work being carried on at several places which will permit a refinement of design so that the weight of the structure can be reduced Thin sheet material is easily fabricated, especially by spot welding, and lends itself to great flexibility in design Low yield strength has been a draw-back which is overcome by the modern methods of rolling and stretching during the fabrication of the strip Flatness and surface finish have also been improved. Material is available in several tempers

	Chromium 18 Nickel 8-Sheet and Strip			
	Annealed	Quarter Hard	Half Hard	Full Hard
Tensile strength (lb./sq. in.)	90 000	125 000	150 000	175 000
Yield strength (lb./sq. in.)	35,000	75,000	110 000	140 000
Elongation 2 in. (per cent.)	40	20	9	5

The chrome-nickel (18.8) undoubtedly has a corrosion resistance superior to aluminum alloys. Spot welded wing structures and floats which have operated for a considerable period of time over salt water indicate very little corrosion Tie rods and control cable manufactured from this type of steel have demonstrated a corrosion resistance much superior to carbon steel, cadmium plated, tinned or zinc coated

Beryllium

Beryllium base alloys are the mirage of the aeronautical engineer They would appear to have excellent properties for aircraft construction but are not available in any form, and the outlook for any production in the near future is hopeless. Copper-beryllium alloys are used to a limited extent for the manufacture of small helical springs and clips in the airplane structure, and in the manufacture of accessories An alloy containing about 2 5 per cent beryllium can be fabricated into the form desired and hardened by a low temperature treatment so that it will have spring properties about half way between phosphor bronze and steel Corrosion resistance in salt spray is equivalent to thet of phosphor bronze.

Forgings for fittings

With the increased loads required by higher speeds it has become necessary to use fittings in which the cross-section may have webs and flanges of several different thicknesses The welding applied to such assemblies has not proved entirely satisfactory due to the incipient cracks and the lack of bond at the junction of sheets which differ greatly in thickness Heat treated chrome-molybdenum or chrome-nickel-molybdenum steel forgings are being used extensively to replace the welded fitting Typical heat treated steel forgings are shown in Fig 2 The forging can be given more liberal fillets and smoother lines than the built up assembly The tail skids illustrated in Fig 3 exemplify the smoother lines obtained with a forging The use of a forging does not insure soundness, however, and it is very essential that any forgings used in aircraft construction be given a very close inspection for laps, cracks and seams as they have proved to be a serious factor and have caused a large number of rejections and a few failures in service. Forgings should be given a light acid etch or examined by means of a magnetic analyzer The DeForest magnaflux system has given excellent results in connection with the inspection of welded steel propellers and fittings, and is directly applicable to the inspection of forgings X-ray inspection has not proved so satisfactory on account of the very fine character of the cracks which are difficult to detect on the film X-ray inspection of die castings, on the contrary, offers an excellent method of determining the location and seriousness of the blow-holes and whether or not they will interfere with the proper functioning of the part Fig. 4 is an X ray photograph of a die casting for an air speed indicator The location and character of the porosity are such that the utility of the casting is not affected.

Fig 4: An X-Ray photograph of a die casting for an airspeed indicator The location and character of porosity are such that the utility is unaffected.

Non-metallic materials

In the field of non-metallic materials the principal development has been in connection with substitutes for rubber which will resist gasoline and oil The new specifications for gasoline resistant hose require an inner tube which is manufactured of specially compounded stock containing approximately twenty parts of rubber and one hundred parts of Thiokol, which is a synthetic rubber made by the chemical interaction of ethylene dichloride and sodium polysulphide This compound resists swelling and softening in the presence of gasoline and oil It can be used as a gasket material for oleo shock absorbers so that petroleum base compounds can be used instead of castor oil-alcohol mixtures The former have a better viscosity relationship at low and normal temperatures, and superior lubricating properties which are desirable for oleo mechanisms

Practically every civil transport and military airplane constructed in the past year was fabricated from aluminum alloy sheets and tubes assembled by rivets The predominating characteristics were a smooth skin monocoque fuselage and internally braced wings with at least the more highly stressed portions covered with flat sheet The development of this type will continue in the future with greater emphasis on the reduction of skin resistance, increase in rigidity of the structure, and economy of manufacture Elimination of rivet heads by the application of spot welding, the use of extruded shapes, forgings, and reinforced joints are paths to this end. Spot welding has received considerable impetus from the invention of accurate timing control by means of vacuum tubes and ingenious mechanical devices Spot welds are superior to the rivets if properly controlled so that uniformity with a predetermined standard is assured.

High Ratings of Several American Aircraft Engines

87 Octane Fuel

Compiled Dec. 8, 1933

Engine	Rating			Weight		Displacement		Fuel Octane No.	Rated Brake Mean Eff. Press.
	Hp	R.p.m.	Altitude (ft.)	Total lb.	per hp lb.	Total cu. in.	Cu. in. per hp.		lb. sq. in.
Wasp	500	2200	11000	725	1.45	1344	2.7	87	134
	500	2200	9000	775	1.45	1344	2.7	87	134
Hornet	700	2000	s.l.	880	1.25	1690	2.4	87	134
	700	2050	6000	856	1.22	1690	2.4	87	164
Conqueror	775	2450	s.l.	1080	1.39	1587	2.05	87	160
	735	2450	5700	1080	1.47	1587	2.16	87	158
Cyclone	715	1950	s.l.	910	1.27	1823	2.55	87	159
	735	1950	3900	919	1.25	1823	2.48	87	164
Cyclone	610	1950	21200	918	1.50	1823	3.0	87	136

Power Plants in 1933

By C. Fayette Taylor
Massachusetts Institute of Technology

THE YEAR 1933 was marked by further increases in the rated output of many models of American airplane engines these increases have been made possible largely by improvement in cooling through better fin design, cowling, and baffling of cylinders, and by improvement in the anti-knock value of available aircraft fuels These factors, in turn, have allowed higher compression ratios and supercharging pressures, with correspondingly increased output for a given size and weight Table I shows some of the higher ratings of a few of the best-known engines

The 650-hp. liquid-cooled Conqueror engine

Fuel makers contribution

The fact that engine manufacturers are now able to specify and obtain a definite minimum anti-knock, or "Octane" value, for the fuel which their engines are to use, constitutes a major step in power plant progress For this due credit should be given to the research work done under the auspices of the Society of Automotive Engineers for the past several years, and to the fine co-operation of the fuel manufacturers That the limit in power-weight and power-displacement ratios has not yet been reached, is indicated by the engines used at the Chicago races many of which were "boosted" to develop over 50 per cent more than their usual rated power, and by several successful laboratory attempts to secure extremely large power from aircraft type cylinders For these tests high supercharging, combined with large valve overlap, have been used Astonishing results have been obtained at Wright Field (High Output Engines AVIATION, October, 1933) I believe that the maximum of 575 lb per sq in brake mean effective pressure constitutes a record, although sleeve-valve engines have nearly equalled it, and may already have surpassed it in confidential tests. Such high outputs have so far been achieved with water-cooled cylinders only The output of present types of air-cooled cylinders is limited to a lower value by considerations of cooling, and therefore, the work now in progress at Langley Field and at the Massachusetts Institute of Technology to determine the best combinations of fins, baffles etc., seems particularly timely (See N A

Pratt & Whitney T1C1 Hornet rated at 700 hp

C.A. Technical Notes Nos. 331 and 429 and Technical Memo No 725.)

The sleeve valve appears

There is an undercurrent of interest, both in this country and in England, in the possibility of using the single-sleeve valve for aircraft engines. This type of valve has been talked of periodically for many years, but is now to have an opportunity to prove itself in service. The new "Perseus" single sleeve valve cooled engine has been announced recently by the Bristol Aeroplane Company of England. Its performance will be watched with intense interest by aeronautical engineers throughout the world.

The large fourteen-cylinder engines in the development stage last year, have been put into service in small quantities by the military establishments, and their progress will also be watched with interest. It is understood that the Army and Navy are sponsoring developments of still larger aircraft engines, but details of these are, naturally, confidential.

What of the diesels?

With regard to compression ignition engines, the hopes entertained a few years ago for rather general application of this type have been definitely on the wane. This is due to a better understanding of the present limitations of this type of engine and its fuel, rather than to loss of hope that it will ever be applied to airplanes. In spite of this situation, it is understood that a number of Junkers "Jumo" engines are in trial service on German airlines. Unfortunately, detailed information as to their success has not reached this country.

It is probable, also, that several types of compression-ignition engines now under development in other parts of Europe will be submitted to service tests in the near future. Already, the Société des Moteurs Hispano Suiza has shown experimental models of the Clerget diesel. This is an air-cooled radial, of rather conventional form, with separate injection pump for each cylinder and

315 hp. for 1825 cu.in displacement is attributed to the Bristol "Perseus," air cooled radial, sleeve valve engine

The twin row Wasp brought out by the Pratt & Whitney Company

the necessary strengthening of cylinder heads, pistons and other parts to withstand high cylinder pressures. The 1933 model is understood to be of considerably larger displacement than previous ones.

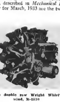
The Bristol Aeroplane Company has converted one or more of their "Jupiter" type engines to the compression-ignition cycle, and it is understood that their operation is quite satisfactory. But both this and the Clerget engine are heavier than a gasoline engine of the same displacement, and the brake mean effective pressure, unsupercharged, seems to be limited to about 100 lb./sq in., for reasonably efficient operation. Comparing this with the mean effective pressures shown in Table 1, indicates the order of magnitude of the handicap under which the compression-ignition engine labors with regard to weight. Few well-informed engineers consider these diesel developments as promising serious competition with gasoline aircraft engines. In the writer's opinion it will be necessary to go to the two-stroke cycle before the compression ignition engine can be taken seriously for heavier-than-air use. It is interesting to note that the most successful one, namely the Junkers, is a two-cycle type.

For lighter-than-air propulsion, the compression-ignition engine is also laboring under a handicap. The principal problem here is to develop a satisfactory method for compensating for the weight of fuel consumed. Since water-recovery from the exhaust does not appear to be feasible with the compression-ignition engine, some other method must be employed. The National Advisory Committee for Aeronautics has found that it is possible to burn sufficient hydrogen along with the fuel-oil to offset the loss in weight of fuel. This is naturally applicable only to hydrogen-filled airships, where this system will probably be used. For helium-filled ships, there appears to be no present good solution of this problem in connection with the compression-ignition engine.

The most important developments in the field of research for the compression-ignition engine have been with regard to the influence of fuel characteristics on the combustion process. Work of this kind conducted in a number of different laboratories indicates that fuel for high-speed, high-output compression-ignition engines will require almost as careful refinement and control as fuel for the gasoline engine. This means, probably, that compression-ignition fuels will not have any great advantage in price over gasoline. On the other hand, the compression-ignition engine should have somewhat lower fuel consumption under cruising conditions than the gasoline engine, and this, coupled with the distinct decrease in fire hazard of the heavier fuel, appears to justify continued research with a view toward aeronautical application.

Engine indicators

In connection with power developments, one cannot omit mention of the successful completion of two new high speed engine indicators which appear to have overcome many of the difficulties of earlier instruments. The Prescott indicator, described in the *S A E Journal* for September, 1932 and the M I T indicator, described in *Mechanical Engineering* for March, 1933 are the two instruments referred to. Both of these indicators have proved themselves in actual laboratory use during the past year, and in the future they should contribute to more rapid progress in the field of power plant development.



The double row Wright Whirlwind, R-1510

Basic work in combustion has been continued in a number of laboratories. This includes work on infra-red radiation from an Otto cycle engine at the Bureau of Standards (See *Industrial and Engineering Chemistry*, April, 1933) and also some interesting work by Dr Schnauffer in Berlin (See S A E paper delivered at the Chicago Automotive Congress). The National Advisory Committee for Aeronautics has recently developed a gasoline sampling valve of improved form which should yield interesting results (See N.A.C.A. Technical Note No 454). Each year work of this kind throws some new light on the complex process of combustion and therefore should be recorded as an important part of power plant progress.

To the question posed in the title, J. A. Roche of Wright Field gave extended answer in a paper read before a recent aeronautical meeting of the Society of Automotive Engineers. He analyzed the sources of destructive flutter in airplanes and pointed out for the designer the paths which must be followed to effect a cure. Herewith, summary of his main points.

Flutter . . . What to Do?

THE increasing use of cantilever structures, particularly in low-wing monoplanes, has brought the question of susceptibility to flutter, buffeting, or vibration into the foreground. They were very much in the foreground at the recent Chicago meeting of the Society of Automotive Engineers, where J. A Roche of Wright Field presented a paper on recent developments in anti-flutter design and revealed the rules that he recommends to assure flutter suppression. Primary factors which determine the potentiality of resonant flutter, he pointed out, are first, the character of the airflow around the airplane, second, the rigidity of the structure, and, third, the design of the control surfaces.

An analysis of the airflow around an airplane in flight shows that there are four distinct sources of structural flutter. The wing tip vortices parallel to the direction of flight, although they absorb considerable horsepower, are in his opinion irrelevant to the present discussion as they do not impinge upon any structural part of the machine. Disturbances of a second type come from the propeller and the slipstream, but, as they are usually of frequencies far beyond those of any member on which they impinge, they seldom can be considered a source of destructive flutter. They may, however, he added, contribute to vibration set up in tie rods in the wings and tail surfaces. Mr. Roche found that in most cases of destructive flutter the vibration is independent of power, and may be felt only with the power off—the slipstream offsetting some of the disturbances caused by the wings and fuselage.

Another type of turbulence to which Mr. Roche called attention arises from the parasite resistance of the fuselage appurtenances, such as cockpits, windshields, etc. Some planes with retracting gears show no tendency to flutter with the wheels retracted, but vibrate dangerously with the gear out at high speeds. In his opinion the obvious cure for such a condition lies in the maximum cleaning-up of the fuselage and its auxiliaries.

The vortices which roll off the trailing edge of a wing are probably the most imporatnt source of tail flutter or buffeting. The energy contained in such vortices may be expressed by

$$hp = \frac{C_{prof}\ AV^3}{096}$$

where C_{prof} is the coefficient of profile drag, A the area and V the speed. It is obvious that the power available from such disturbances may be very large, particularly at high speeds and at high angles of attack. It is greater for thick wings he said than for thin, and that portion of the power liberated near the wing root which is in a position to impinge upon the horizontal tail surfaces is relatively large. Mr. Roche finds that most low-wing monoplanes are subject to buffeting in some degree, and trouble occurs if resonance with the structure takes place. His suggested cure lies in straightening out the flow along the fuselage by means of large fillets, or by reversing the trailing edge near the fuselage. (The N.A.C.A. finds that good engine cowling may in some cases be more important than wing to fuselage fillets.) Although the frequency of such disturbances is not known precisely, he remarked that it has been estimated that the pitch of such waves is approximately five times the thickness of the turbulent area behind the trailing edge.

Mr. Roché observed that as a result of airflow tests in flight and tunnel, it has been found that oval tie rods vibrate most violently when they are set either at zero angle of attack or at some angle well above their burble point. In rigging ships, therefore, he said it is important that tie rods be set at some intermediate angle of attack to avoid a flutter which might shorten their lives materially.

Structural rigidity

The rigidity of airplane structures has, until recently, been thought of in terms of static deflections. It has been recognized, however, the speaker declared, that it is better to consider rigidity in terms of natural frequency of vibration and through a special apparatus developed by Weaver and Stutz at Wright Field, whereby impulses of known frequencies may be applied to airplane parts, a number of significant general facts have been discovered. For example, wood wings of the cantilever type can be vibrated both in torsion and in bending, metal wings are distinctly more rigid in torsion and vibrate preferably in bending, tie rods vibrate at frequencies determined by their mass, length and tension (conversely, the knowledge of their frequency permits accurate calculation of their tension), fuselages prefer to vibrate in torsion, rarely in lateral bending and not at all in vertical bending, it is possible to locate visually the axis of motion of structures while vibrating them, the natural frequency of airplane parts is little affected by air loads or air speed, and finally, it is possible to measure the interesting frequencies of most airplane parts without the use of special suspensions—the airplane may rest on its own landing gear during the test. The speaker had found the natural frequency of airplane structures to be constant and independent of amplitude up to the point where marked deformation, as shown by slackening wires or wrinkling of stressed skin sections, occurs.

The Air Corps now specifies a minimum frequency of from 600 to 1,200 cycles per minute in most structural parts to insure rigidity. For engine mounts, a natural frequency somewhat above idling speed is desirable. Trouble also occurs in power plants, due to resonance of natural propeller-blade periods with crankshaft speeds or with the number of explosions per minute. Mr. Roche considers that the most undesirable type of power-plant vibration occurs from oscillations normal to the plane of radial engines. Designers should attempt therefore to restrain such motion, and to permit only angular motions about the crankshaft axis controlled through the hysteresis of rubber cushions or grommets or some other form of damping device.

Other points which Mr. Roché cautioned must be watched in the design include a careful avoidance of eccentricities in members and in joints, a

selection of types and dimensions in wing bracing to give minimum deflection in all directions; reinforcement of cockpit edges and the provision of adequate gusset plates to transmit torsional shear around all openings; elimination of play in all joints of the structures and control systems; and the rigging of sufficient initial tensions in wires to avoid any slackening during any normal flight maneuver.

Control surface design

In Mr Roché's opinion, the most profitable point at which to start in attacking any problem of flutter elimination, is in a redesign of the control surface. The most important things are to keep control surfaces as light as possible and in dynamic balance both about their own hinges and about the natural elastic axis of the supporting structure. These two precautions will prevent the lag of the control surface, which he considers a potent source of flutter. Static balance alone sometimes does little good, he finds, and requires more additional weight than necessary. This point is of great importance. Adding weight to control surfaces increases their inertia and may actually be dangerous in spins. He cited a case where complete static balancing of the control surfaces of a pursuit ship increased the total weight by 60 lb., obviously an undesirable feature.

In thinking about the dynamic balancing of control surfaces, Mr Roché advised that the following facts be borne in mind. (1) The elevator may be agitated by either a torsional oscillation of the fuselage or a bending oscillation of the stabilizer, the location of the natural axis being not very different in the two cases; (2) a rudder may be agitated by either a fuselage torsional oscillation, or a fin bending oscillation (in the latter case, the portion of rudder aft of the hinge and below the torsional flexural axis of the fuselage assists dynamic balancing); (3) where fin and stabilizers are tied together with tie rods the only elastic oscillation which need be considered is that of the fuselage in torsion; (4) with ailerons on cantilever wings, the elastic axis is difficult to locate, but it may be estimated by taking the intersection of the deflected hinge line with the undeflected hinge line; (5) ailerons balanced dynamically for torsional oscillation of the wing will practically require static balance (torsional oscillation of metal wings, however, is not so likely to occur as bending, unless the skin is weakened by large or numerous apertures); (6) for externally braced wings the wire attachment point may be assumed to be the center about which the tip and aileron will rotate; (7) perfect dynamic balance is seldom necessary and it is not recommended if it must be secured by addition of much dead weight; (8) surfaces must not be overbalanced aerodynamically. (It has recently been found that it may be desirable to statically balance servo control surfaces or trim tabs.)

Coefficient of dynamic balance

In order to afford some basis of comparison of dynamic balance among control surfaces of various kinds, Mr Roché finds it desirable to express it as a non dimensional coefficient. This may be written as

$$C_{db} = P_1/WA$$

Where C_{db} is the coefficient of dynamic balance, P_1 the product of inertia of the surface in question (the summation of the weight of all the units of the member, multiplied by their respective distances from the axis of vibration), W the total weight and A the total area. Since, he explained, the product of inertia really represents the shaking power of the control surfaces, the coefficient of dynamic balance is actually the ratio of shaking power to size. As a general rule the value of this index should be below 0.1, but where speed is great and rigidity questionable Mr Roché feels it should approach zero or even have a negative value if it is desirable to use the control surface as a damper to possible oscillations.

Due to the great possible number of disturbances and the wide range of frequencies to which airplane structures are exposed Mr Roche found that it was impossible to adjust the natural frequencies of all parts beyond such vibrational ranges. In order to avoid too perfectly elastic structures, however, he thought some elements possessing hysteresis might have to be placed in the joints of major parts to absorb energy and to prevent resonance. The speaker remarked that it had been suggested that airfoils might have to be made with flexible trailing edges like those of birds to prevent or to soften the trailing vortices which cause so much trouble on tail surfaces. Until further studies of the frequencies of air disturbances yield more positive results, he added, the natural frequencies of all structural elements should be raised as much as practicable without adding too much weight.

Notes for test pilots

In concluding his paper Mr Roché gave a number of hints to test pilots. Of great interest they must be quoted verbatim.

"Parachutes should be worn; cabins should be open; safety belts should not be too strong as to make forced egress unsafe to the pilot, and intentional egress should be convenient.

"At the first sign of flutter the throttle should be closed at once and the airspeed reduced slowly, for a sudden change to higher angle of attack at high speed is almost sure to bring on vortices having still greater energy than those which originated the flutter.

"All small flutters should be reported and the airplane grounded until they have been investigated and eliminated.

"Airplanes should be carefully inspected for tightness of control surface hinge brackets and tightness of the whole control system. Cables should have an initial tension of about 100 lb which should eliminate all play in bearings.

"Wire braced structures should be designed so that wires will not go slack in frequently performed maneuvers. Initial tension should be checked with some fairly accurate instruments.

"In type tests some automatic flutter stops, consisting of sprung weights which latch in place automatically upon the appearance of flutter should be mounted on the parts suspected of likelihood of flutter."

Replying to questions put by Ralph Upson and the editor of AVIATION (who suggested that with recent metal constructions which are very nearly perfectly elastic, especially those assembled by welding, resonance may build up to greater violence than in the old wooden constructions having more hysteresis) during discussion, Mr Roché expressed conviction that most cases of wing collapse originated in aileron flutter due to faulty dynamic balancing. In his opinion, control surface vibration would never be a serious problem if the structure on which the surface was mounted was perfectly rigid. Real trouble occurs from the combined vibration of the control member and the supposedly rigid structure. Fortunately, from a standpoint of weight saving dynamic balancing of control surface is to be preferred to static balancing.

Genealogy of AVIATION

AVIATION was founded by Lester D. Gardner, the first issue appearing Aug. 1, 1916, as *Aviation and Aeronautical Engineering*. In 1920 the *Aircraft Journal* was absorbed and the title became *Aviation and Aircraft Journal* to be simplified into AVIATION in January, 1922. The chief editors have been Ladislas d'Orcy, W. Laurence Le Page, Earl D. Osborn, R. Sidney Bowen, Jr., and Edward P. Warner.

The present staff consists of Edward P. Warner, editor; Leslie E. Neville, managing editor; S. Paul Johnston, assistant editor; and David J. Leisk, art director.

E D I T O R I A L S

AVIATION

EDWARD P. WARNER, *Editor*

A Break for the Private Pilot

WE HAVE just recently been talking to a friend—a forward-looking man who has never had any direct connection with the aviation business. He has been thinking of learning to fly, and he came in to tell us that he had decided not to do so. "I had understood," he said, "that I could get all the necessary training for $400, but now the school that I have been corresponding with tells me that it is marked up to $800, and if it is so much of a job as to be worth all that I'm afraid it is beyond me." Note one victim of last spring's decision to increase the number of hours for a private license to 50. Now we jubilantly record at least one step to make the lot of the new pilot easier.

WE SEE no public danger in the decision just taken in the Department of Commerce to retrace in a general way the steps of the last few months and to reduce the minimum number of hours for the lowest grade of pilot's license from 50 to 25. That still seems excessive. We feel that if adequate attention were given to the temperamental qualifications of prospective pilots, it would not be necessary to give so much to the number of hours in the air. The British consider themselves regulation-ridden beyond all endurance, yet British regulations affecting student training and private piloting are infinitely less onerous than our own. After a period in which our own regulations were becoming more and more severe, the Department of Commerce has relaxed them to a degree. We earnestly hope there will be further relaxation, and we believe that there can be without public danger.

IN PARTICULAR, we believe that further progress can be made along a line on which the new Department rule already represents very definite improvement. Henceforth the private pilot will have to go to an approved flight surgeon only once in two years for a renewed examination, instead of annually as in the past. That is good, but it is not yet good enough. We believe that the whole concept of medical men especially approved for aviation work ought to be swept overboard where the private pilot is concerned. We believe that thoroughly adequate tests for vision and hearing can be given by a flight inspector at a flying field, and if the responsibility is put upon the inspectors we believe that on the average they will prove better qualified to judge temperamental qualities and nervous stability than are the doctors. If a general physical examination still seems necessary at intervals it should be given by any licensed physician whom the applicant may select. That is our platform, and it has been for some time. We have heard a certain amount of vehement denunciation of our position, but no one has yet made any serious attempt to supply any evidence that we are wrong. Until the believers in specialized medical examination by specialized personnel for pilots of all grades can provide some definite testimony to the rightness of their own position, we shall continue to believe that there can be further relaxation of the rules, at least to the point of bringing the American regulations to a parity with those of other countries where private flying is popular. Until then, we shall continue to hope that the present very welcome action of the Department is but a beginning, with much more to come.

[At the instant of going to press, we receive the notice of a $400,000 Public Works allotment for preliminary development of a low-priced quantity-production plane for the private owner. Private flying is on the way and the United States Government is behind it as never before.]

Where Do We Go From Here?

ON NOV. 8, as the final outcome of more than two months of debate over detail, the President attached his signature to the Air Transport Code, and it became part of the law of the land. On Dec. 19 the newly-organized Air Transport Code Authority, representative of all groups in the transport field, held its first meeting. The second stage under the new regime, so far as air transport is concerned, has just begun. No one yet knows just what can be done by an industry empowered to practice full self-government, but we are about to learn. The Code Authority finds itself immediately confronted by certain responsibilities. Its first task is to deal with those, without worrying too much for the moment about what may develop in future.

FIRST of the immediate duties is the supervision of new routes and extensions Henceforth no route may be established until its sponsor shall have filed with the Code Authority "evidence of compliance with such standards and conditions of operation . . . as the Administrator upon the recommendations of the Code Authority . . . may approve as reasonable and in the interests of fair competition" The "standards and conditions" have not yet been determined, but it is plain that there can be no such guarantee of monopoly on a route as was included in the original draft of the Code, and that on the other hand there will be no open door for competition which makes its way by cutting the compensation of employees, by giving a low-grade service of inferior reliability or safety, or by running on a seasonal basis, skimming the cream off traffic peaks and suspending operations during periods of low traffic-density That will be something gained, although it still seems to us that the emasculation of the original Code has gone too far in this section, and that there should be authority in someone to prohibit any new operation under present conditions on routes that are already being efficiently served and that obviously offer so small a total traffic that if competitive services are offered both parties are sure to operate at a loss

The Code Authority has also to devise and require (after approval by the Administrator) a uniform system of transport accounting It has further to "require periodical reports . . . with respect to revenues, expenses and other charges, wages, hours of labor, conditions of employment, number of employees, and other matters pertinent to the purposes of this Code . . . " The air transport business and all those concerned with its destiny ought to have a much improved idea of where it stands and where it is going in future if this statistical work is adequately done

These are the immediate activities of the Authority as imposed by the Code itself As we have already suggested, there should be more in the future The trade practice sections of the Code as it now stands are, to put it mildly, rudimentary There is opportunity for an immense amount of co-operative effort, agreed upon by the members of the industry and if necessary enforced upon the laggards or the recalcitrants

IN General Johnson's letter to the President, accompanying the dispatch of the Transport Code, he estimated an increase of 15 per cent in the number of employees on the lines under the new rules Taken together with increases of material and other costs under NRA conditions, the air lines will face a gross increase in annual expenses of some two to three million dollars for the present amount of operation To prevent any weakening of their financial position, or any lowering of their ability to purchase new equipment of increased efficiency as rapidly as it becomes available, the gross revenues of the lines must be increased by nearer five million dollars than three (since increased revenues generally mean that increased traffic must be handled and more schedules operated) That is something for the Post Office Department and the Bureau of the Budget to bear in mind when the estimates for next year's air mail appropriations are being laid out, but it is also a point for the industry to consider on its own account Whatever may be done on the air mail, these increases of operating costs make it doubly important that passenger traffic be stimulated and its growth further accelerated That in turn makes co-operation doubly important, for we have always to remember that the real competition of a large transport operator comes not from any other operator but from that great section of the public that has not yet adjusted itself to the practice of regular travel by air If every operator in the United States except one (any one you like) were to go out of business the survivor certainly could not increase his passenger revenues on his present routes by more than a million dollars a year, but it is conservative to say that the amount of passenger traffic that ought to be in the air and has not yet arrived there amounts not to one million dollars a year but to between twenty and fifty million The Transport Code is a new invitation to join in a united drive upon that mine of golden possibilities as yet untapped

Welcome Home

UNFORTUNATELY all the superlatives in the English language were used up in 1927, so there are no fresh ones left to be applied on the occasion of the return of the Lindbergh family from foreign parts. We who are in the business know that the 30,000-mile trip just completed at College Point six days before Christmas was in its way a much greater achievement than the lone hop from Roosevelt Field to Le Bourget six years ago, we know that the best thing that can be said about Colonel Lindbergh's successive expeditions is that he makes the most magnificent of feats look easy, we know that infinite care in preparation, immense experience, and rare skill and judgment have put good fortune as an element of success into its proper position, and that an extremely minor one, and we know, best of all, that the trip just ended has been a true forerunner of regular intercontinental air transport as no single record-breaking flight ever could be. Six years ago the same pilot detached himself from the world for 36 hours, his fate unknown, beyond the reach of human communication. This year, accompanied by a skilled navigator and radio operator, his traverses of wide seas were punctuated by routine reports coming into Miami every few minutes and with heartening regularity Equipment changes and methods and purposes change, but commerce does not lose the need for the pioneer To the Great Navigator, twentieth-century edition, we extend our share of the greetings and congratulations of an aeronautical world that always felt an assured confidence that he would do whatever he planned.

NEWS OF THE MONTH

Ayes have it

RETURNS from Aeronautics Branch Director Vidal's low-priced airplane survey among 34,000 licensed pilots, mechanics, and student permit holders (AVIATION, December, page 382) continue to show a strongly affirmative reaction to his question "Would you buy a plane of the order described if it could be made available?" The 17,730 answers received during the first three weeks of the survey revealed a total of 9,437 expressions of willingness to buy, 53 per cent of the total number of responses An additional 3,327, or 19 per cent, qualified their readiness to purchase with certain restrictions. Asked for the number of individuals who to their personal knowledge would purchase a plane of the type specified, the airmen mentioned some 38,000, this figure, however, includes duplications presumably many of them Negative replies totaled 4,966, or 28 per cent of the returns Allowing for the fact that these figures represent only about one-half the total number of possible returns which is already a remarkably large percentage, as questionnaires go, and that, furthermore, they are the expression of those persons most likely to be interested in the scheme, and that many of them would not come through when they reached the point of paying the check, still, the tone offers some proof that a potential market does exist for a sound, factory-built plane to sell for under $1,000 Once the survey is completed, it will remain to be seen what the aircraft industry or the Department of Commerce, or both, will do about it

CWA airport program

Continuing his active program of encouragement to the private flier by providing increased facilities for landing, Director Vidal announced that 2,000 landing fields will be established by means of an allocation of $10,000,000 from the Civil Works Administration Two hundred and fifty representatives of the Aeronautics Branch have been appointed to assist in the approval of all such airports as members of state CWA staffs Though every effort will be made to distribute the fields so as to provide the utmost service to pilots and aircraft any city, town, or village in the country which does not have adequate landing facilities is invited to apply for an emergency field under the present program A particular object is to provide emergency fields in thinly-settled areas where flying may be especially hazardous, and where no individual community has felt inclined to assume the expense of clearing and grading a landing area The municipalities must provide the land, cities and states will be asked to loan road building machines, while the CWA will provide the money for labor and materials Engineers designated by the Aeronautics Branch will examine the proposed sites If they prove suitable, work will be started at once, since a main purpose is to provide immediate work for the unemployed.

A proposal from George B Post, president of the Edo Aircraft Corporation, that 2 per cent of the $10,000,000 be diverted to set up a chain of seaplane terminals along the Atlantic seaboard was submitted to Director Vidal.

The application of the Aeronautics Branch for $1,500,000 of PWA money for experimentation with a seadrome, to be one of a chain across the Atlantic (AVIATION, December, page 382) met with a chilly response from Secretary Ickes, who stated that the floating airfields would not be built unless foreign governments would insure their neutrality by financial co-operation.

Amateur pilot license

Still with an eye to the unhampered development of private flying, insofar as is consistent with public safety, the Aeronautics Branch issued amendments to the Air Commerce Regulations liberally extending the privileges of those who fly for pleasure A new grade of amateur pilot license was created, designed to bridge the gap between the student permit, which now will be valid for two years instead of one, and the private license grade. Holders of student permits are eligible for the amateur license after 25 hours of solo flying, as contrasted with the 50 hours required for application for the private license. Minors are required to have the written consent of parents or guardians In addition to a physical examination, which must be given by a designated medical examiner of the Aeronautics Branch, the applicant for an amateur license must pass written examinations on the Air Commerce Regulations and air traffic rules, and take a flight test, essentially the same as that for private pilots except that he will not be required to go into or recover from spins, nor make cross wind take-offs and landings He will be allowed to pilot licensed aircraft, but he may not carry persons except licensed transport, limited commercial or private pilots, and these shall be in dual-controlled aircraft. Private pilots may now carry non-paying guests, and may demonstrate aircraft in flight to prospective buyers. Relaxation of the medical requirements for private pilots, which apply equally to the amateur pilot, permit them to take physical examinations every two years instead of annually. It is now necessary that private pilots take the same flight tests as prescribed for transport pilots, with the exception of the cross-country flight Student pilots may make solo cross-country practice flights but they are not permitted to make landings on airfields where flying meets are in progress unless the field is their home base. New ratings for Department of Commerce approved schools were established for the new grade of license, as amateur flying school and amateur and private ground school Recently the Department eliminated the written examination requirement for pilots applying for license renewal though as formerly they must pass a physical examination and flight test.

D. of C. aids transport

With PWA's $1,187,478 allotment to the Aeronautics Branch for the installation of lighted airways, five new links will be forged in the great federal chain. Airways will be established from Minneapolis, Minn to Seattle, Wash ($655,445), St Louis, Mo, to New Orleans La ($161,169), Tulsa, Okla., to St. Louis Mo ($143,454), Galveston-Houston-Waco Tex ($71,730), Fargo-

Calendar

Jan 8—Maintenance Committee, Air Transport Section of Aeronautical Chamber of Commerce, Atlanta, Ga

Jan 11—Doherty Trophy Race, Orlando, Fla., to Miami preceded by U S Amateur Pilots Association Third Annual Winter Cruise

Jan 11, 12, 13—Sixth Annual All-American Air Races Miami Fla.

Jan. 22-26—Annual Meeting, Society of Automotive Engineers Detroit.

Jan. 25—Annual Meeting, Aeronautical Chamber of Commerce, New York.

Jan. 31—Annual Meeting of The Institute of the Aeronautical Sciences Inc. New York.

February — Viceroy's Challenge Trophy 700 mile race, Delhi India.

Feb 9-18—Pan American Races—Dedication Shushan Airport, New Orleans La.

April 27-May 6—International Show of Sport & Touring Aviation, Geneva, Switzerland

May 27—Deutsch de la Meurthe Cup Race.

Pembina, N. D. ($55,680). The northern transcontinental route, long anticipated by the Pacific Northwest, will run from Seattle through Spokane, Washington, across Montana via Helena, and Glendive, thence to Fargo, N. D., and Minneapolis. The Fargo-Pembina route will provide direct service between two great grain centers, Chicago and Winnipeg by connecting the latter with the northern transcontinental route. A direct central north-south route will be provided by the St. Louis-New Orleans airway.

New services

United Air Lines punctuated the establishment of new winter schedules last month by reducing its fastest coast-to-coast 20-hour service to 19½ hours. Seattle and Spokane, Washington's two largest cities were recently connected by United with daily round-trip passenger express service. Philadelphians are now provided with direct service to Cleveland, Toledo and Chicago in 3-mile-a-minute Boeings which connect at Chicago with planes flying to Kansas City, to the southwest, and to the Pacific Coast. With its fleet of new type Boeing twin-engined monoplanes in service, United has retired all tri-motors. Only single-engined equipment now in use are the all-metal Boeing mono-mails on the Kansas City-Omaha-Watertown route and Boeing Forties on the Seattle-Spokane and Spokane-Pasco runs. Through addition of passenger transports to its night schedules, Pennsylvania Airlines now make connections with United's New York-Chicago planes to provide dusk-to-dawn service between Chicago and Washington. Taxi service between Atlanta, Ga., and Warm Springs, 55 miles or 35 minutes apart, is operated by Eastern Air Transport in twin-engined Curtiss Kingbirds, making one round trip daily and connecting with airlines flying regular day and night schedules between southern cities and Philadelphia and New York. Fifteen per cent reduction on all round trips is a feature of the Kohler Aviation Corporation's rate-slashing program on their cross-lake Milwaukee-Detroit Airline. A combined air-rail service between New York and Montreal has been initiated by the Rutland, Vt., railroad.

The California Chamber of Commerce is promoting further development and improvement, as regards landing fields and lighting equipment, of a coastal airway between San Francisco and Los Angeles, and has issued an exhaustive report of progress.

An airline from Chicago to Harmon Airport, N. Y., with direct plane-to-train connections into New York City is being considered by the New York Central Railroad. A traffic survey to that end has been conducted.

A round-the-world air tour in 57 days is one of the regular scheduled trips offered by Thomas Cook & Sons, including a flight from Pernambuco, Brazil to Seville, Spain, on the Graf Zeppelin. A steamer-crossing of the Pacific Ocean is the one link not made by air.

TRAIL-BLAZING FLIGHT

Lindbergh's exploratory flights form the current series of the survey program of Pan American Airways, which has done considerable research toward the establishment of commercial routes to Europe. Purpose of the survey: to secure specific data pertaining to characteristic conditions over sections of the Atlantic. Pan American is at present negotiating with the Portuguese government for permission to land in the Azores and on Portuguese territory on a regular transatlantic service

NRA code authority

Members of the Aeronautical Chamber of Commerce elected to serve on the Air Transport Code Authority under the NRA are E. R. Breech, president of North American Aviation, H. S. Martin, president of Pennsylvania Air Lines, W. A. Patterson, president of United Air Lines, L. D. Seymour, president of American Airways, J. T. Trippe, president of Pan American Airways System. At an election supervised by a committee appointed by the NRA, consisting of Paul Collins, vice-president of the Boston and Maine Airways, Eugene L. Vidal, director of aeronautics for the Department of Commerce, and Edward P. Warner, editor of AVIATION, Temple Bowen of Bowen Airlines and T. E. Braniff of Braniff Airlines were chosen to serve on the Code Authority as non-members of the Chamber. Presidential appointees are W. W. Howes, second assistant postmaster-general, Earl E. Hughes, of the NRA, and E. L. Vidal. The first full meeting of the Code Authority was held on Dec. 19. The proposed code for the aircraft manufacturing industry had its public hearing, which lasted only two hours, on Dec. 20. Briefs were presented in support of the code, which proposes a minimum wage of 40 cents an hour and a maximum work week of 40 hours for non-executive personnel, by Leighton Rogers, vice-president of the Chamber, and Col. E. V. Rickenbacker, vice-president of North American Aviation, Inc. For the A. F. of L., Merle Benton, urged a minimum wage of $19.50 per 30 hour week.

Wage scale arbitration

Continuing his efforts to settle the wage controversy between airline operators and the Air Line Pilots Association (AVIATION, November, page 354; December, page 382) Senator Robert F. Wagner summoned representatives of both sides to a hearing before the National Labor Board at Washington on Dec. 14, in order to obtain their comment on the report of the fact-finding commission which had been circulated among all concerned.

OFFICIAL PHOTOGRAPH, U. S. NAVY

NATION'S NEWEST CARRIER

U.S.S. Ranger, first of our naval vessels to start from scratch as an aircraft carrier, approaches completion at her berth at Hampton Roads, Va.

Non-military Japanese airfield

Allegedly for commercial purposes, the Japanese are planning to build an air base on Saipan Island in their mandate area in the South Seas to study atmospheric conditions, assist their fisheries, and improve communications. Though its classification as non-military is obligatory under the terms of the Washington Naval Treaty of 1921, which prohibits extension of military facilities, such a field would have enormous value as a military base for scouting operations over the waters of the Philippine Islands.

Millions for defense

Curtiss Hawk fighting planes will be produced in China under the supervision of American engineers, according to a co-operative agreement between Curtiss-Wright Aircraft Corporation and the Chinese National Government. The Chinese, who have obligated themselves to buy or insure the sale of 60 planes annually, will import only motors once the $5,000,000 factory at Hangchow is completed. Any one of the nine models of Wright Cyclone engines may be used in the Curtiss Hawk. As the plane is designed for high altitude flying, the Cyclone R-1820-F power the majority. After demonstration by Maj. James H. Doolittle 50 Hawks were sold to China during the past year through William Pawley, Curtiss-Wright's representative in China.

The Nanking government's program of "National Salvation by Use of Aircraft," calling for a fighting strength of more than 700 planes, presents a rich market to manufacturers in which the Americans to date have very successfully met the competition of the British and Italians.

Another contract in the export field was recently signed by Curtiss-Wright Corporation and the U.S.S.R., whereby Wright Cyclone and Curtiss Conqueror engines will be manufactured in Russia under American supervision. (AVIATION, December, page 385)

Passage to Europe

The data assembled by the Lindberghs in the course of their five months' flight of 29,081 miles, touching four continents, will place in the hands of Pan American Airways, to whom Colonel Lindbergh is technical advisor, one of the most significant documents ever compiled in the interests of trade route development.

Intensive exploration of the Labrador-Greenland-Iceland area, testing the feasibility of a North Atlantic airline route to Europe, occupied the first two months of the expedition, covered 5,500 miles. With the supply ship Jellinge, sent from Philadelphia by Pan American as a base, the Lindberghs made daring flights over storm-laden waters in search of harbors and havens for future transport planes. Twice crossing the Greenland ice-cap for the purpose of topographical study, they concluded the most complete survey ever accomplished of the little-known island. Insisting on being regarded as a couple of private citizens bent on sightseeing, they toured Europe, visits to airports and talks with European aviation officials occupied an important place in their sightseeing schedule through Denmark, Sweden, and Norway, Russia, Estonia, the British Isles, France, Holland, Switzerland, Spain, and Portugal.

Climax of the homeward journey, via the Azores and the Canary Islands, was the South Atlantic crossing from Africa to South America. Reports of their progress and location were radioed every fifteen minutes of the 1,800-mile, sixteen-hour flight, by Mrs. Lindbergh, navigator for the entire expedition, to Pan American stations in the U. S. Flying up the Amazon River as far as Manaos, they traversed 900 miles of dense jungles and mountains to Trinidad, thence to Porto Rico and the Dominican Republic. On Dec. 16, the red-and-black Lockheed seaplane landed in the waters of Biscayne Bay at Miami, Fla., on United States territory for the first time since taking off from North Haven, Me., last July.

30 years of flight

The 30th anniversary of Orville Wright's pioneer flight at Kitty Hawk, N. C., on Dec. 17, 1903, was celebrated in Washington in ceremonies organized by the National Aeronautic Association. At Philadelphia, over the same week-end, Mr. Wright attended the dedication ceremonies of the aviation section of the new Benjamin Franklin Memorial and Franklin Institute Museum in the organization of which C. T. Ludington has taken an active part.

Navy projects

The $7,500,000 allotment under the National Industrial Recovery Act of 1933 to the Bureau of Aeronautics, Navy Department, will be divided under six headings.

Procurement of 130 new aircraft, including engines and radio and other instruments, $6,114,391; Purchase of aircraft instruments, $213,250; Purchase of aircraft radio equipment, $457,759; Improvement of aircraft power plants, $489,600; Aircraft structural alterations, $50,000; Manufacture of new airplane landing devices, $175,000.

Bids on the new aircraft will be sought shortly. They will be for replacement purposes to maintain the present 1,000 plane program.

Appointments

President Roosevelt has appointed Eugene L. Vidal a member of the National Advisory Committee for Aeronautics to succeed Dr. William F. Durand, of Leland Stanford Junior University, resigned. Dr. Durand had been a member of the committee since its creation in 1916. The Aeronautics Branch, Department of Commerce, thereby gains direct representation on the N.A.C.A.

Dr. R. E. Whitehead of Indianapolis, Ind., State Governor of the National Aeronautic Association, has been placed in charge of the Medical Section of the Aeronautics Branch, Department of Commerce, to succeed Dr. Eldridge S. Adams, resigned. All medical examina-

tions for pilot licenses and renewals will be supervised by Dr. Whitehead.

Bennett Griffin of Oklahoma (world flier of 1932) and Charles F. Dycer of California were appointed aeronautical inspectors in the field service of the Department of Commerce, in the Dallas and Chicago areas, respectively.

Miscellany

The aviation industry relief fund committee, under the chairmanship of J. T. Trippe, president of Pan American Airways System, was the first to fulfill its quota this year of the 87 industries enlisted in New York's Citizen Family Welfare Committee Drive.

The Sperry Corporation and its subsidiaries, the Sperry Gyroscope Company, Inc., and the Ford Instrument Company, Inc., have leased office space in the RCA building at Rockefeller Center. Another subsidiary, Intercontinent Aviation, Inc., will be located in the same building, whither Curtiss-Wright also moved a month ago.

The Pitcairn Autogiro Company announces that it has suspended manufacturing until further notice, although it will continue to maintain adequate facilities for servicing autogiros that are in use. Development work on the autogiro will be carried forward vigorously, in anticipation of design of new models.

The Sportwing, latest design of the Kinner Airplane and Motor Corporation, Ltd., Glendale, Cal., has received a Department of Commerce approved type certificate. Similar to the Kinner Sportster, the Sportwing is a two-place side-by-side low-wing monoplane, powered with the Kinner 125 hp. engine. Cruising range is four hours at 104 m.p.h.; 108 lb. of baggage can be carried.

The Institute of the Aeronautical Sciences has opened New York City quarters, beautifully decorated, on the 54th floor of the RCA building at Rockefeller Center.

Personnel

Charles A. Rheinstrom has been appointed general traffic manager of American Airways to succeed F. Warren Oakes, resigned. Mr. Rheinstrom was formerly served as traffic manager for the company's eastern division and Chicago district.

Arthur L. May, formerly city traffic manager at Boston, has been appointed to the New York office, replacing Ralph S. Maugham, who has been placed in charge of the Chicago division. J. F. Wheelock will succeed May in Boston.

Maj. V. E. Bertrandias, formerly sales manager for General Manufacturing Corporation, has sailed for Japan as sales representative for General Aviation and B-J Aircraft Corporation products in the Orient. Charles Froesch, general aviation service manager, will now handle all sales matters.

Northwest Airways announce the appointment of A. G. Kinsman as West Coast traffic manager with headquarters in Seattle. Stewart F. Auer has been appointed western division traffic manager for the line.

Mrs. Phoebe Omlie, well-known pilot long active in maintaining flying service in Memphis, Tenn., and as an entrant in National Air Tours, has joined the National Advisory Committee for Aeronautics. Mrs. Omlie will be concerned particularly with the problems of the private pilot.

SIDE SLIPS
By Robert R. Osborn

WE SEE by the papers that the new Curtiss Condors are being equipped with sleeping berths very similar to Pullman berths. This is a big step in improving the comfort of the pilot. It will be a much nicer place for him to look over the financial pages of his morning paper, while the co-pilot does the flying.

"Anchorage, Alaska, (AP). The 'flying dentists office' of Alaska was destroyed by fire Monday. A cabin monoplane owned by an Anchorage dental clinic, it had carried Dr. Lawler Seeley thousands of miles to relieve aching molars of many isolated miners who otherwise would have to suffer, miles from a dental chair."—Buffalo *Evening News*.

We had not known there was an airplane in existence equipped in this fashion. If Dr. Seeley is as absent-minded as our present dentist, his patients would be continually protesting in this manner, "Pardon me, Doctor, but I think your nurse-mechanic has mixed up your equipment again. That is the welding torch you are trying to put in my mouth, and I'm sure that fluid you just put in my tooth was either bituminous paint or doping solution."

We have always heard the claim that aviation will never get ahead until we forget about the romance of it, and make it into an ordinary business. We

can't think of a better way of completely destroying the romance, so far as the very young generation is concerned, than to have an airplane outfitted as a dental office.

You had probably thought that the days were gone forever, when one had to look into the rear end of the airplane fuselage, before making a flight, to make sure there were no bird's nests, rabbits or sleeping mechanics back there. However, Lloyd Child beard a very loud squeaking when he started to warm up a ship at the Buffalo

airport the other day, and, looking around, saw a large rat jump out of the tail skid opening and run into the hangar.

ISTRES, France, Nov. 5—(AP) A great French armada of 27 planes manned by 84 picked aviators started a mass flight to Darkest Africa early today.

The first squadron of 15 machines net balance, \$1,288,542,344.82, cues from their propellers blowing berets from the heads of many in the small cheering crowd.

Clipping sent in by A. H. H. of Williamstown, Mass., who wishes to know why there should be any cussing in a bunch of aviators with a balance like that?

Among the other railroad traditions which have been adopted by the airlines is that of taking liberties with geography in preparing maps. The old time flying instructor always used to warn his student never to try flying cross-country using only a railroad map for guidance—and the present day instructor might well offer the same advice in regard to published airways maps. As was the case with the railroad maps, the airline becomes absolutely straight from one terminal to the other, and all important cities very mysteriously fall on that straight line. If necessary to show competing lines on the same map, they always seem to wander all around the countryside, apparently just for the purpose of missing all important cities.

FLYING EQUIPMENT

Top to bottom:
Curtiss A-12 attack.
Douglas Y10-43 observation.
The Curtiss XF11C fighter.
Curtiss YO-40A observation.
Martin XT5M dive bomber.

1933 Development in Military Aircraft

MILITARY secrecy fences the design and production of military aircraft off from the curious eye and covers them with a thick blanket of silence, and it is easy for anyone who hasn't actually been engaged in the field to overlook the tremendous amount of experimental work that the American industry has carried on on behalf of the Army and Navy in the past two or three years. Some of the results of experiment in 1931 and 1932 are just coming to light with the first releases of photographs, and although it is even yet impossible to quote performances, it is quite safe to say that some of the speed and climb figures are remarkable. The photographs alone go far to confute the pessimist who still periodically proclaims the inferiority of American military aircraft to the corresponding European types. Publication of complete descriptions and performance data, we may be quite certain, would wipe out the last trace of any such delusions.

Conspicuous among the new types for the army are the Curtiss and the Douglas observation planes, the former made in two models. All three designs have now reached the service test stage. The

Douglas is a wire braced monoplane while one of the Curtiss ships (illustrated on page 5) is a strut-braced parasol monoplane and the other (page 29) a sesquiplane. The gull wing of the Douglas Y10-31 has been supplanted by a straight wing. The Douglas machine has a Curtiss V-1570 engine and a rigid landing gear of single-strut type, while both Curtiss models use the Wright Cyclone engine and retract the landing gear into the fuselage. All of these observation planes, like practically all new Air Corps machines for whatever function, have the pilot cockpit inclosed. All use three-bladed propellers, also in accordance with a practice increasingly common on all military types. All adhere to the Air Corps standard in using sheet-duralumin monocoque fuselages. An interesting feature of the Douglas is the deepening of the fuselage at the rear cockpit by an excrescence on its lower surface to give the gunner a better position when standing. The horizontal tail surfaces are mounted well above the top of the fuselage, in accordance with the recommendations for avoiding blanketing of the rudder during a spin that have been derived from the spinning tests of the N.A.C.A and other laboratories.

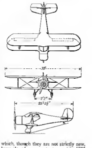
In the attack group the latest arrival is the Northrop (picture on page 5), a low wing cantilever monoplane with Cyclone engine and all-metal wing structure of the familiar Northrop type. The close kinship with the Delta and Gamma is immediately evident. The two sides of the landing gear are quite independent and are cantilevered, with total inclosure of the wheel and all its supporting members inside the streamlined shell. The engine has a full N.A.C.A cowl in place of the ring that has been more common in Air Corps machines, the form of the cowl being modified by reducing its diameter immediately behind the engine along the lines developed by the Air Corps some three years ago.

A production attack type of which photographs are just available is the A-12, a Curtiss attack machine following the general lines of the better-known A-8, but with a Wright Cyclone engine installed in place of the liquid-cooled Conqueror. The A-12 has various points of general similarity with the more recently developed Northrop, but its low wing is wire-braced from the landing gear. The engine has a ring instead of a full cowl, and the cockpit inclosure covers only the rear cockpit, the pilot being in the open.

A striking Air Corps acquisition in the pursuit field is the Consolidated with a geared Curtiss V-1570 engine with an underslung radiator, retractable landing gear and complete cockpit inclosure. The ship (page 5) bears the earmarks of speed. The Boeing P-26 with supercharged Wasp, now on order in quantity for the Army and described in AVIATION in November) is likewise a low-wing monoplane. (Photograph on page 3) Closer to past American conventions are the navy's latest fighters, though the Grumman FF-1, described in AVIATION last month, has retractable landing gear and cockpit inclosure, among other novelties. The Curtiss XF11C-2 follows the general pattern of Curtiss Hawks of the past two years, with a single-strut landing gear providing an opening in which a bomb may be slung and dropped and with landing-gear maintenance facilitated by using "pants" cut away over the entire area of the low-pressure tire on the outside of each wheel.

There are other machines upon which full data have not yet been released and which, though they are not strictly new, have played so important a part in 1933 that they cannot be overlooked as the year draws to a close. The Martin bomber, permanently enshrined in history as the first heavy machine to exceed 200 miles an hour, is illustrated on page 5 in its latest production form. The Martin dive bomber designed for lighter loads and different tactics, has been playing in the navy a part corresponding to that of the new monoplane for the Air Corps. Finally, there is the latest of naval flying boats, the Consolidated P2Y1 (picture on page 3), with twin engines in nacelles below the wing, which made history in the recent squadron flight from Hampton Roads to the Canal Zone and for which a squadron trip from California to Honolulu is promised in the near future.


Artist's Conception of the 225 hp Beechcraft



The Royal Air Force's Gloster Gauntlet

British Fighter the Gloster Gauntlet

THE Royal Air Force has long recognized two distinct types of fighting planes. There is the "interceptor" designed particularly to start from the ground at the warning that bombing planes are approaching London and to get to their altitude and put them out of action before they can reach their objective and let their bombs go. Superlatively high performance is preeminent, and any necessary sacrifices will be made to secure it.

There is, on the other hand, an all-round fighter built to quite different specifications, a machine that must have plenty of maneuverability and plenty of strength, good endurance and much military equipment, and good performance under fighting conditions. Typical of the first class are the Hawker Fury and Fairey Firefly,—of the second, the Bristol Bulldog and now the Gloster Gauntlet, just ordered in quantity by the R.A.F.

With its supercharged Bristol Mercury radial reported to hold 560 hp up to 16,000 ft., the Gauntlet's speed is officially announced as 216 m.p.h at that altitude. Also included in the performance report are a minimum speed of 54 m.p.h., a climb to 10,000 ft. in 5.5 minutes and to 20,000 ft. in 11.75, and a service ceiling of 33,000 ft. Carrying two guns, radio, and racks for four 20-lb. bombs, the weight all up is 3870 lb. The fuel capacity is 100 American gallons, which presumably allows about three hours at cruising speed.

The ship is derived from the Gloster S.S.6 six-gun fighter of a few years ago, dropped when the Air Ministry turned thumbs down on the multi gun fighter as a type, at least for the time being.

A two-bay biplane of the conventional British form, the wings are of thin section. The fuselage is of steel tubes, assembled by riveting, and the wing spars of riveted steel strip, all of which is common British custom. Less common is the use of duralumin wing ribs, and of mixed steel and duralumin construction in the tail.

New Beechcraft with Lower Power

A NEW version of the Beechcraft, embodying many of the characteristics of the present model but lower in power and price is to be introduced in the near future. The new model has a 225 hp. engine instead of the 420 hp. Wright Whirlwind power plant of its predecessor and part of the lost performance is regained through the use of a retractable landing gear. A soundproof cabin and elevator trimming tabs to replace flight adjustment of the stabilizer are also included in the innovations. The negative stagger characteristic of the earlier model is retained.

The new Beechcraft has a wing span of 32 ft., an overall length of 24 ft. 5½ in. A cruising speed of 145-155 m.p.h is expected and a cruising range of from 550 to 650 miles should be possible with the field capacity provided.

In general arrangement the wing cellule resembles that of the earlier models. High aspect ratio ailerons extend the full length of the wings (lower) and are differentially operated providing an upward travel of 45 deg. to improve control at high angles of attack. Aileron hinges are equipped with sealed ball bearings.

Both the main landing gear and the tail wheel retract fully.

Particular attention has been given to details of interior arrangement and finish. To facilitate entry and eliminate wasted aisle space, the right front seat is made to slide backward. Sufficient space is provided for four persons to sit in comfort with out being cramped.

All controls are within easy reach, the operation of the trimming tabs being effected through a knob located close to the throttle in the center of the dash. A bent safety glass windshield, also used on the larger Beechcraft, is a feature of the new design.

New Bellancas, the Senior Series

AERODYNAMIC improvements which lead to better performance and new features which make for pilot and passenger comfort characterize the new Senior Bellanca airplanes. Both the Pacemaker and Skyrocket models appear in the new series.

Both ships are of the six place cabin type of the well-known Bellanca form. Full N.A.C.A. cowling has been added, however, and the formerly abrupt connection between the wing and the fuselage has been well streamlined with a metal fillet. The usual Bellanca landing gear is equipped with a streamlined wheel, fitted with streamlined tires. A new tail wheel unit has been applied, full castoring to 360 deg. and equipped with shock absorber.

The fuselage for both models has been widened, which gives increased aisle width and more comfortable passenger seating. The pilot's compartments are fitted with a throw-over wheel control, adjustable seats and a wide instrument panel of new design insulated against vibration by a shock mounting. Instruments are indirect-lighted and the board carries small compartments or lockers similar to those found on modern automobiles. Two sets of throttle controls are fitted, left-hand on the pilot's side, right-hand on the co-pilot's side rather than the more common single throttle either on the dashboard or between the seats.

The Bellanca Senior Skyrockets are produced in two models: the Standard, powered with the Pratt & Whitney "Wasp SC-1" 450-hp. engine, and the De Luxe, with the Pratt & Whitney "Wasp S1D1" 525-hp. engine. The difference between the two lies in the power plant equipment and the fact that in the Senior Skyrocket DeLuxe the customer has a wider choice of finishes, upholstery, as well as more instruments, including artificial horizon, directional gyro, bonding and shielding for radio, special folding combination couch chair and other extras. It has a top speed of 183 m.p.h. with a useful load of 2,300 lb. and a range of from 910 to 1,280 miles.

The Senior Series Pacemaker is powered with the Wright 420-hp. Whirlwind or the Pratt & Whitney 400-hp. Wasp Jr. The Senior Pacemaker is adaptable for executive, sports, or air-line use.

As with all former Bellanca models, both the Senior Skyrocket and Pacemaker, may readily be adapted for seaplane service by mounting on Edo twin floats. The general specifications are:

	Senior Sky rocket	Senior Sky rocket De Luxe	Senior Pacemaker
Span (ft. in.)	50 6	50 6	50 6
Length overall (ft. in.)	27 11	27 11	27 11
Height overall (ft. in.)	8 6	8 6	8 8
Wing area (sq. ft.)	311	311	311
Weight empty (lb.)	3 150	3,300	3,000
Useful load (lb.)	2,450	2 300	2,350
Gross weight (lb.)	5 600	5 600	5 350
Top speed (m.p.h.)	¹171	²183	³160

¹At 6 000 ft., ²At 7 000 ft. ³At sea level.

Socony Vacuum Corporation's Bellanca Senior Skyrocket

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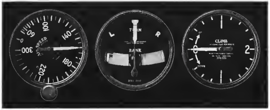

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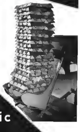

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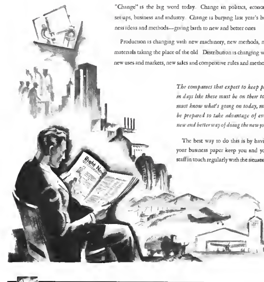

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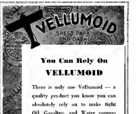

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